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Intermediate Glass Processing

Glass can be recovered from municipal solid waste (MSW) and reused in new products, especially glass containers. Crushed, clean glass added to glass furnaces is called cullet.

The use of mechanical processing systems to recover cullet from mixed MSW is currently in the developmental stage. Mechanical recovery systems—as reported in other *NCRR Bulletin* articles—are installed in four full-scale resource recovery plants in the U.S. At present, however, virtually all of the "post-consumer" cullet recovered from the waste stream is supplied by so-called "source separation" programs in which house-holders and other consumers keep recyclable items (glass bottles, metal cans, newspapers) separate from other solid wastes. The separated items are then collected and returned to manufacturers for recycling. Most of the glass is not in a form in which it can be fed directly into a manufacturer's glass furnace. Upgrading the quality of the cullet and transportation services may be performed by "intermediate glass processors" (IGP)—organizations that play an important part as middlemen in the glass recovery and reuse circuit. This article will review the development of the intermediate glass processing step to recycling.

Most glass recovered from municipal solid waste today is returned to glass furnaces for the production of new beverage containers.

Glass Recovery

MSW is estimated to contain an average of 10 percent (by weight) glass.[1] Glass recovered from MSW has the potential to be used in the manufacturing of a variety of products including new glass containers, brick, glass wool insulation, "Glasphalt," and abrasives.[2,3] Most glass recovered from MSW today is returned to glass furnaces for the production of new beverage containers.

It is normal practice to charge a furnace with both cullet and virgin materials. Glass container manufacturers typically use cullet as 10-to-15 percent of their raw material feed into the furnace.[4] Manufacturers are constantly experimenting with using large quantities of cullet, with one reportedly using more than 50 percent. For the most part, however, the cullet used is "in-plant" rather than post-consumer. In-plant cullet consists primarily of rejects from the container manufacturer's quality control system and of broken bottles from the manufacturer's brewery and bottler customers.

There are several advantages of using recovered MSW glass as cullet in glass container production, other than simple replacement of virgin raw materials. It allows the glass furnace to be operated at lower than normal temperatures, decreasing fuel consumption in the furnace and extending the life of the refractory lining of the furnace.[5] Also, air emissions have reportedly been reduced when cullet has been substituted for a portion of the raw materials.[6] Conditions at individual furnaces vary, as does the extent of the noted advantages realized.

Glass container manufacturers, who closely monitor the quality of raw materials entering the glass furnace, have worked with the American Society for Testing and Materials to develop specifications for post-consumer cullet. **Table I** lists initial experimental specifications as recommended by the Glass Packaging Institute (GPI) for glass from resource recovery systems other than froth flotation. **Table II** lists the tentative specifications for glass from froth flotation systems. The specifications include upper limits on the amounts of organics, magnetics, nonmagnetic metals and refractories allowable in cullet to be used in the manufacturing of glass containers.

Two important aspects of the specifications for cullet are limits on contamination by refractory particles and limits on the color mixture of the cullet.[4,7] Refractory particles are heat resistant, nonmetallic minerals which may survive a glass furnace melt and form solid inclusions or "stones" in the glass container. The presence of stones can result in aesthetic flaws or structural

defects in the glass product, leading to rejection of the bottle as a matter of quality control. The color mixture of cullet must be controlled, especially if the cullet is to be used in producing flint (clear) glass, which represents 70 percent of the industry's production. Cullet containing colored glass is limited primarily to use in the manufacture of new green and sometimes amber bottles.[8,9,10] Amber represents about 25 percent and green represents about 5 percent.

Sources of Cullet

The two major sources of cullet for IGP's are post-consumer and industrial. Most of the *post-consumer* glass containers recycled today are recovered in source separation programs.[11] By keeping materials separate from the basic waste stream, source separation programs attempt to recover them in a clean, readily recyclable form. The total costs and the extent of citizen participation vary with the type of source separation program. In any case, citizen cooperation is very important to effecting and maintaining this separation.

The segregated articles can return to the material flow scheme in several ways. The simplest way is delivery by consumers to a central location or depot, often called a "recycling center."[12,13] Such a depot may be sponsored by a municipality, environmental group, container manufacturer or intermediate processor. Consumers may be paid for materials received, or they may simply return the materials out of a public-spirited motivation.

Most post-consumer glass containers recycled today are recovered in source separation programs.

One example of a successful multi-material statewide collection center activity is that of the Beverage Industry Recycling Program (BIRP) in Arizona. A review of this was reported in the Spring 1978 NCRR Bulletin, "Source Separation: The 'Recycling Center' Approach."

Another approach to returning recyclable materials is the curbside collection system, which some municipally-sponsored source separation programs employ. For the purposes of this report, the recycling center and the curbside collection approaches are collectively referred to as community source separation programs.

Post-consumer glass also comes from commercial sources such as restaurants and bars, and from beverage retailers in exchange for deposits paid when the beverage is purchased. The deposit system operating in several states requires that a deposit on glass and metal beer and soft drink containers be paid by the consumer to the retailer. Upon return of the containers—either to a retailer or to a redemption center—the deposit is refunded. Usually, the redeemed bottles and cans are collected from retailers by wholesalers or distributors. Refillable bottles are returned to bottlers for cleaning and refilling, while the other bottles must be disposed of or processed into cullet. Cans are either voided and disposed of or sold to aluminum and steel companies. In the deposit system, therefore, the wholesaler, retailer and consumer must all perform sorting, transportation and storage functions, with increased costs at each level.

Since any form of source separation requires the direct and continuing in-

Table I

GPI-Recommended Specifications for Glass From Resource Recovery Systems (except Froth Flotation)

1. A preponderant portion of glass cullet will be soda-lime bottle glass: SiO_2 69-75, Al_2O_3 1-4, CaO + MgO 9-13 and Na_2O 12-16 weight percent.
2. The sample shall show no drainage and be non-caking and free flowing. A moisture content of less than 0.5 wt. % is required to meet the free-flowing characteristics of cullet, which is predominantly of smaller particle size (<16 U.S. mesh, <1.18 mm, or smaller).
3. **Particle size:** 100% <50 mm, <15 wt. % <.11 mm (140 U.S. mesh)
4. **Organic Materials:** <0.2 wt. %
5. **Magnetic Metals:** <0.5 Wt. % with no particle >6 mm
6. **Total Inorganics:** <.1% of dry sample. No particles >6 mm
7. **Refractory Materials:** The following limits shall apply with no particles >6 mm

Particle Size, p mm	*No. of Particles Permitted*
p >.85 (>20 U.S. mesh)	1 per 18 kg of sample
.85<p>.43 (20x40 U.S. mesh)	2 per 450 g of sample
.43<p>.25 (40x60 U.S. mesh)	20 per 450 g of sample

8. **Nonmagnetic metals:** All particles must be smaller than 6 mm. Particles larger than 0.9 mm (20 U.S. mesh), no more than 1 particle per 18 kg.
9. **Allowable Color Mix for Color-Sorted Glass:**

*Flint Glass**	95-100%	Flint
	0-5%	Amber
	0-1%	Green**
Amber Glass	90-100%	Amber
	0-10%	Flint
	0-10%	Green
Green Glass	50-100%	Green
	0-35%	Amber
	0-15%	Flint

*Flint glass containing over 0.1% Fe_2O_3 and/or 0.002% Cr_2O_3, as determined by chemical analysis, shall be considered mixed color glass.

**Flint glass can contain up to 1% emerald green or 10% Georgia green, or a combination within these limits. Note: (1% of Georgia green equals 0.1% emerald green).

Source: Glass Packaging Institute, 1978

Table II

Tentative Composition Limits for Waste Glass from Froth Flotation as a Raw Material for the Manufacture of Glass Containers

1. A preponderant portion of glass cullet will be soda-lime bottle glass containing: SiO_2 66-75, Al_2O_3 1-7, CaO + MgO 9-13 and Na_2O 12-16 weight percent.
2. The sample shall show no drainage and be non-caking and free flowing. A moisture content of less than 0.5 wt % is required to meet the free flowing characteristics of cullet which is predominantly of smaller particle size (<16 U.S. mesh, <1.18 mm, or smaller).
3. **Particle size**: 100% <50 mm, <15 wt %, <0.11 mm (140 U.S. mesh)
4. **Organic Materials**: <0.2 wt %
5. **Magnetic Metals**: <0.14 wt % with no particle >6 mm
6. **Other Inorganic Materials**: In the particle size range >0.85 mm (20 U.S. mesh), <0.1 wt %. For particles in the size range smaller than this, <0.5 wt %. No particles >6 mm.
7. **Refractory Materials**: The following limits shall apply with no particles >6 mm.

Particle Size, p mm	*No. of Particles Permitted*
p >.85 (>20 U.S. mesh)	1 per 18 kg of sample
.85<p>.43 (20x40 U.S. mesh)	2 per 450 g of sample
.43<p>.25 (40x60 U.S. mesh)	20 per 450 g of sample

8. **Nonmagnetic metals**: All particles must be smaller than 6 mm. Particles larger than 0.9 mm (20 U.S. mesh), no more than 1 particle per 18 kg.

Source: Glass Packaging Institute, 1979.

Community waste glass being received for intermediate processing at Glass Containers Corp. in Dayville, Conn.

volvement of the citizenry, a public education effort is essential for success. The public must first be motivated to participate, educated to the desired procedures to follow, informed about undesirable contaminants (with glass, the contaminants include stones, ceramics, metals, etc.) and then regularly reminded about the program.

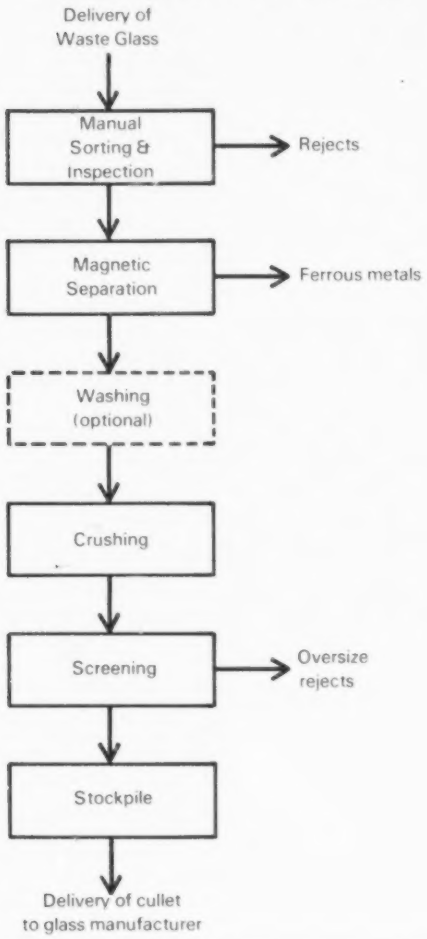
Other techniques have been developed to minimize contaminants of recyclables. Central collection points for bottles in several European cities have large containers with separate compartments for three colors of glass.[4] Bottle-size openings in these compartments discourage the public from leaving materials other than glass bottles. The responsibility of providing relatively contaminant-free bottles lies with the public. Unless an attendant is stationed at the recycling depot (as sometimes occurs at recycling depots in the U.S.) the only other method to remove contaminants would be at the intermediate processing level.

Waste glass must be recovered to specification for successful marketing.

Industrial-derived cullet is the second major source for the IGP and it has long been used in glass container manufacturing. This glass is relatively clean compared to community source-separated glass. One source of industrial glass is the in-plant cullet retrieved from breakage at the glass manufacturing plant. Broken bottles and other rejects from bottlers and breweries are also major sources of glass for intermediate processors and glass container manufacturers. The food processing industries, window and door manufacturers, and the lighting industries also supply glass of different manufacturing specification to IGP's and glass manufacturers. In general, this glass is processed separately because of different constituents.

Waste glass must be recovered to specification for successful marketing. Ideally, cullet removed from MSW would be free of metals and refractory particles and would be color-sorted, but householders or retailers participating in source separation programs seldom

Figure 1
Typical Flow Diagram for High Volume Intermediate Glass Processing



fully comply with such standards. Because of the voluntary nature of most source separation programs it is difficult to maintain quality control and to provide a reliable supply of cullet. To meet market specifications, some processing of the materials is usually necessary. In the case of glass bottles, this involves removal of metal (e.g., aluminum rings and caps) and other contaminants from the glass, color sorting, and crushing. Processing of waste glass for use as cullet can also include blending batches of cullet to dilute the effects of variation in color mixture. Blending also occurs at the site of the glass container manufacturer where in-plant cullet and cullet from other sources may be blended together.

The Intermediate Glass Processor

In response to increased source separation of waste glass and because of the

It is estimated that about 70 percent of the post-consumer cullet recycled in the U.S. is processed by intermediate glass processors.

Intermediate Glass Processing

need to provide quality control and a reliable supply of post-consumer cullet, *intermediate glass processors* have emerged.[1] This report defines intermediate glass processors as those who acquire post-consumer glass, beneficiate the glass in an attempt to meet market specifications, and sell the cullet to glass manufacturers. It is also common for IGP's to market aluminum and ferrous metal, recovered as by-products of glass processing.

IGP's are "intermediate" in two respects. First, they are important middlemen in the recovery of post-consumer waste glass because they provide marketing and upgrading services needed by the beverage retailers (who receive containers returned for deposit), recycling programs (which provide collection points or recycling drives) and glass manufacturers (who use cullet in their furnaces). By upgrading and transporting glass, IGP's may help to reduce some of the costs normally associated with community source separation and solid waste disposal programs.

Intermediate glass processors usually remove ferrous metals magnetically and then crush the glass to meet size specifications.

IGP's are also "intermediate" in the level of technology used to upgrade glass. Although many IGP's upgrade their glass principally through manual picking and sorting operations common to community recycling projects, some also use mechanical processing equipment such as crushers, magnets, screens and washing systems to beneficiate the cullet. Some of these mechanical processes are similar to those found in large-scale resource recovery plants,[1] but as of now, IGP's do not employ capital-intensive glass recovery processes (*e.g.*, froth flotation or optical sorting) to recover cullet from mixed municipal refuse.

Scrap and secondary material dealers of metals, waste paper, etc., are, of course, traditional intermediate processors. In earlier years, they were also cullet dealers. Then because of more

Table III: Intermediate

Intermediate Glass Processor/Location	Appx. Monthly Tonnage Processed	Comments
New England Area		
Barrett Trucking		
Burlington, Vt.	800	All glass is received from beverage distributors. Trailers are left at large distributorships and picked up as needed.
Maine Beverage Containers		
Portland, Maine	1500	Beverage retailers started this company that recycles glass, paper, cardboard, aluminum and plastic.
Maine Recycling Corp.		
Topsham, Maine	1500	Long-time salvage dealer processes aluminum, ferrous, and paper as well as glass.
Matcon, Inc.		
Salem, Mass.	800	The company receives more than 75 percent of its glass from individuals, recycling projects and source separation programs. Matcon contracts out all transportation arrangements.
Recycling Enterprises, Inc.		
Oxford, Mass.	3000	Glass is collected from a radius of 300 miles from the processing plant. Although glass is obtained from many sources, more than 50 percent is from community recycling efforts.
Binghamton, N.Y.	50	
Berlin, N.J.	planned	
Resource Recovery Systems, Inc.		
Branford, Conn.	300	The company will accept color-mixed glass and mixtures of glass and cans. All transportation arrangements handled by private contractors.
Tiverton Recycling		
Tiverton, R.I.	1000	All glass received is from community recycling efforts. Glass must be color sorted and preferably free of metal.
Waste Control		
White River Junction, Vt.	<100	Processing glass is a small part of this refuse hauler's operations. Glass is crushed in trucks.
West Coast Area		
ABC Recyclers		
Medford, Ore.	300	Although business is geared toward glass processing, profit margins are hurt by transportation costs. Also recycles paper & aluminum.
Circo Glass Co.		
Madera, Calif. Los Angeles, Calif. St. Louis, Mo	10,000 for the three plants	The plants process glass and plastic. The California plants process significant portions of mixed cullet. The only requirement for incoming glass is that it be relatively free of food wastes.
San Leandro, Calif.	not reported	

Glass Processing in the U.S.*

Intermediate Glass Processor/Location	Appx. Monthly Tonnage Processed	Comments
Clayton Ward Co.		
Salem, Ore.	400	The main plant in Salem processes paper and aluminum as well as glass containers, the majority of which come from beverage distributors. The two other plants, which only recently began operating, have no magnetic separators or crushers.
Kennewick, Wash.	80	
Redding, Calif.	not reported	
Sessler Scrap Co.		
South Gate, Calif.	1000	Most glass received is plate glass & waste glass from bottles. Processing includes washing operations.
Other Areas		
American Glass & Reclaiming Co.		
Jacksonville, Fla.	600	Processing plants only treat cullet. The company, which manufacturers crushers and magnetic separators, may plan more processing plants to be operated by two or three men.
Tampa, Fla.	400	
Bassichis Co.		
Cleveland, Ohio	6000	A long-time producer of cullet, Bassichis acquires most glass from automobile & window companies and bottlers. Processing includes washing operations.
Cincinnati Cullet Co.		
Cincinnati, Ohio	400	The company processes mostly mixed cullet received from bottlers and breweries. Processing includes washing operations.
Container Recovery Corp.		
Marion, Ohio	2500	Plant handles only Anheuser-Busch beer bottles and cans.
Dlubak Cullet Co.		
Natrona Heights, Pa.	not reported	The company accepts glass from a wide variety of sources but it must be exceptionally clean. Processing includes washing operations.
Keystone Cullet Co.		
Greensburg, Pa.	2000	Accepts all types of waste glass. Processes and markets specialty cullet in almost 300 colors.
Recom		
Milwaukee, Wis.	4500	Local recycling groups, brewers and distributors supply most of the glass.
Recycle Unlimited		
Grand Rapids, Mich.	90	Most of the glass is received from recycling programs and from recycling depots. Paper, cardboard, aluminum and plastics also are recycled.

*This list is compiled from information obtained from representatives of the facilities noted.

Crushed glass coming off conveyor at Recom facility in Milwaukee.

economical techniques in glass manufacturing and the ready availability of relatively low-priced raw ingredients of glass (primarily sand, soda ash and limestone), the role of the cullet dealer diminished. In recent years, however, there has been renewed interest in glass recycling, which IGP's help stimulate by concentrating and upgrading supplies of glass from many sources.

An attempt has been made to identify major IGP's throughout the U.S., and to gather information on their institutional origins, operating procedures, and equipment and tonnages processed. Production capacities of the individual plants range up to 4,500 tons per month. Combined, they can process approximately 40,000 tons of cullet each month. It is estimated that about 70 percent of the post-consumer cullet recycled in the U.S. is processed by IGP's.[6]

Some details on individual IGP's are summarized in **Table III.** The table lists the location, reported capacity, and general comments provided by each plant operator.

As suggested by Table III, IGP's vary considerably in size and institutional origins. Organizationally, intermediate glass processors may be non-profit civic groups, scrap dealers, or private entrepreneurs in business only for this purpose. Other types of organizations that have begun processing glass containers include refuse haulers, trucking com-

Intermediate Glass Processing

Cullet fines from one of two processing lines at Recycling Enterprises, Inc., plant in Oxford, Mass.

panies, community recycling projects, breweries and soft drink bottlers. Glass Containers Corp. in Dayville, Conn.; Owens-Illinois plants in Portland, Ore., Winston-Salem, N.C., and Charlotte, Mich.; and Northwestern Glass Co. in Seattle, Wash., are examples of glass manufacturers who serve as intermediate processors at their own plant sites.

Although some IGP's rely solely on post-consumer glass containers as their source of cullet, most IGP's process cullet from industrial sources as well. Glass recovered from these sources and to a lesser extent from deposit systems is relatively free of contaminants. On the other hand, glass recovered through community source separation programs tends to have a higher degree of contamination.

Some IGP's have been in the scrap industry for many years, often processing plate glass and other forms of industrial waste glass. Although total tonnages of cullet processed by these dealers are significant, several of them treat only very small amounts of post-consumer glass containers. Generally speaking, the scrap yards discussed in this report have a wider range of waste glass sources and markets than other intermediate processors.

The growth of intermediate glass processors has been particularly noticeable in the populous Northeastern states, where an estimated 70 percent of the community glass recycling in the U.S. occurs.[1] Several conditions exist in New England that are conducive to the development of IGP's. These include high disposal costs for refuse, landfill siting problems, environmental interest on the part of the public, deposit systems, the existence of numerous community source separation programs and available markets for cullet.

Most IGP's in the northeastern section of the U.S. are receiving $30-to-$40 per ton for their cullet, although—depending on quality and quantities—some IGP's receive more. Processors in the Pacific Northwest receive about $30 per ton. A typical IGP processing 1000 tons per month of glass would receive sales revenues of about $35,000 for the cullet alone. Recovery of aluminum and bi-metal cans would increase sales revenues.

Unlike full-scale resource recovery plants which process mixed refuse, IGP's do not receive tipping fees for processing material that would otherwise have to be disposed of. IGP's frequently pay recycling groups for collected glass and many IGP's obtain glass from retailers or industries at no cost. One IGP said he is paid for picking up glass containers from retailers.

Table IV: Equipment Used

Equipment	Functions	Manufacturer*
Conveyor Belt	• Allows manual inspection and contaminants removal	Bonded Scale Machine Co. 214 Bellevue Ave. Columbus, Ohio 43207
	• Feeds bottles to magnetic separator or glass crusher	Jeffrey Manufacturing Co. P.O. Box 1879 Columbus, Ohio 43216
	• Feeds cullet to storage bins or trailers	Link Belt Co. FMC Corp. Homer City, Pa. 15748
		Rexnord, Inc. P.O. Box 2022 Milwaukee, Wis. 53201
Magnetic Separator	• Separates ferrous metal from glass stream	Dings Co. 4740 W. Electric Ave. Milwaukee, Wis. 53246
		Eriez Magnetics Asbury Rd. at Airport Erie, Pa. 16512
		Stearns Magnetics Inc. 6001 S. General Ave. Cudahy, Wis. 53110
Crusher	• Reduces size of glass particles for economical transport and for efficient feeding of glass furnaces	American Pulverizer Co. 1249 Macklind Ave. St. Louis, Mo. 63110
	• Flattens malleable metal contaminants such as aluminum caps to facilitate removal by screening	Gruendler Crusher & Pulverizer Co. 2915-17 N. Market St. St. Louis, Mo. 63106
		Heil Co. 3000 W. Montana Ave. Milwaukee, Wis. 53201

Methods of Processing

There is some variety among the processing schemes employed by IGP's but, generally speaking, the process flows are quite similar and are not particularly complex. Two approaches are used to remove contaminants from the glass and to maintain color separation. One method is to pick the contaminants and other contraries from the glass stream. Although more tonnage could be processed, cullet quality may suffer somewhat. **Figure 1** is a simplified flow diagram utilized by the typical, high volume processor. Since they tend to seek industrial, commercial and clean community sources for much of their waste glass, the product that the high volume IGP deals with is relatively clean.

Intermediate glass processors are generally more labor intensive than recovery plants designed to handle mixed municipal refuse.

A second approach is to remove the glass from the contaminants and produce a smaller amount of a color-sorted and presumably cleaner product. **Figure 2** is a simplified flow diagram used by low volume IGP's (such as Resource Recovery Systems, Inc.). The low volume IGP can process relatively contaminated glass—often mixed with cans—and still produce a cullet to market specifications. Resource Recovery Systems, Inc., achieves a consistently high quality glass product by hand picking bottles from a moving conveyor; the yield, however, is relatively low.

Manual sorting and inspection occur in order to ensure that most of the glass is generally color-sorted and free of aluminum, ceramics and other contaminants. Almost all processors have chosen to remove contaminants and refractory particles manually as a first step in processing. Currently, little beyond public education and limited handpicking and screening is being done to ensure the absence of refractory particles. IGP's usually remove ferrous metals magnetically and then crush the glass. Crushing is necessary in order to meet the size specifications (see Tables I and II), required by the glass manufacturer. Also, by decreasing the particle size, and thus increasing the bulk density of the cullet, transportation costs may be reduced. Screening, washing or secondary magnetic separation are sometimes employed as final steps before the cullet is shipped to glass manufacturers.

Table IV contains a list of equipment commonly used by IGP's and manufacturers of such equipment. However, much of the equipment is often designed and fabricated by the individual IGP—sometimes with the help of local machine shops. One reason is that some "off-the-shelf" crushers, hammers, etc., have difficulty withstanding the abrasiveness of glass. GPI has developed a prototype crusher/screener for use by an intermediate glass processor to remove caps, neck rings and labels. Magnetic separators and conveyors are likely to be purchased from major manufacturers. Generally speaking, the salvage yards use a more sophisticated level of technology than other intermediate processors. The salvage yards, for example, have routinely employed washing and screening; such operations, especially washing, are not common among the newer IGP's.

Several processors, expressing interest in marketing their processing systems either with or without operating

in Intermediate Glass Processing

Equipment	Functions	Manufacturer*
Crusher (cont'd)		Jeffrey Manufacturing Co. P.O. Box 1879 Columbus, Ohio 43216
		Pennsylvania Crusher Co. P.O. Box 100 Broomall, Pa. 19008
		Williams Patent Crusher & Pulverizer Co. 2701-2723 N. Broadway St. Louis, Mo. 63102
Screen	• Removes caps and rings from crushed glass • Removes oversized glass particles	Allis-Chalmers Corp. Crushing & Screening Equipment Div. 3033 W. Spencer St. Appleton, Wis. 54911
		Barber-Greene Co. Aurora, Ill. 60507
		Gruendler Crusher & Pulverizer 2915-17 N. Market St. St. Louis, Mo. 63106
		Iowa Manufacturing Co. Cedar Rapids, Iowa 52406
		Link Belt Co. FMC Corp. Homer City, Pa. 15748
		Universal Engineering Corp. Cedar Rapids, Iowa 52405

*These are a few of the manufacturers that market equipment used in intermediate glass processing.

Intermediate Glass Processing

contracts, estimate that an initial investment of between $50,000 and $300,000 is required to begin an intermediate glass processing operation.

Although a few IGP's process color-mixed cullet, it appears that only a limited market exists for this product. Most processors utilize manual color sorting techniques to ensure that glass is color-sorted. A few processors, however, are investigating the optical sorting of glass mechanically.

Quality control appears to be largely dependent on visual observation of the cullet as it leaves the plant. IGP's are usually limited in their ability to affect the quality of the cullet (*e.g.*, by color sorting or removal of refractories), and so must rely heavily on their suppliers to provide reasonably clean and color-sorted waste glass. Thus, collection of glass containers from source separation programs with small amounts of contaminants is important in maintaining quality control. None of the IGP's contacted for this report performs any routine laboratory analysis of the cullet. A few IGP's reported that their cullet was analyzed for contaminants in the container manufacturer's laboratories.

There is increasing interest by glass container plants to use greater percentages of cullet in glass manufacturing. A major impediment heretofore has been the near absence of a service that, at a reasonable price, could regularly provide predictable quantities of quality (to specification) waste glass. The intermediate processor fills that role. As glass managers gain confidence in these suppliers, it can be expected that greater amounts of waste glass will be utilized.

Three operational factors appear to influence the success of an IGP: *economies of scale, transportation management* and *labor management*.

The plants that appear to be economically viable are those processing relatively large (at least 1000 tons per month) amounts of glass. The processors appear to have access to large amounts of industrial and commercial glass. As indicated, these sources usually provide cleaner glass than that from community source separation programs, often color-sorted. Some of the "successful" processors have controlled transportation costs by backhauling waste glass after delivery of cullet or by centrally locating between suppliers and users.

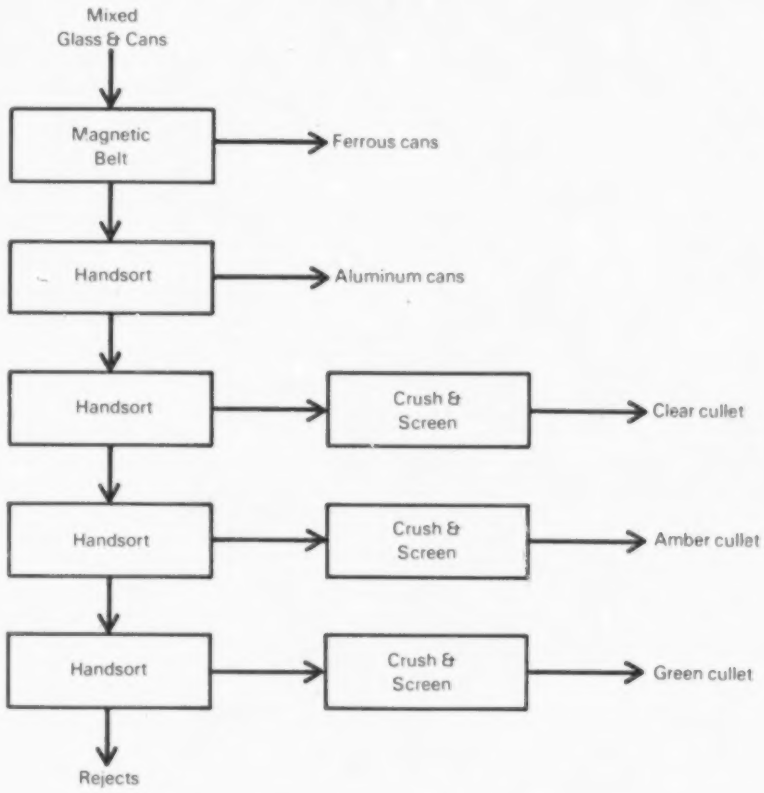
The number of persons employed by the IGP's surveyed range from 3 to 30, with 5-to-8 persons being typical. Some of these employees may be truck drivers or clerical workers and some are associated with other activities the IGP may be pursuing (*i.e.*, paper collection, metal recycling, etc.).

IGP's are generally more labor intensive (as are community recycling projects) than recovery plants designed to handle mixed municipal refuse. Although the amount of manual labor utilized might place upper limits on the amount of glass that could be processed, most IGP's report they could process twice the amount if the glass were available.

An indication of the importance of these success factors can be obtained by comparing two intermediate glass processors, Recycling Enterprises, Inc. (REI) of Oxford, Mass., and ABC Recyclers of Medford, Ore. REI, which processes large amounts of industrial and commercial waste glass, has based the growth of business on community cullet which now represents 50 percent of its inflow. This company, which also

It is estimated that an annual investment of between $50,000 and $300,000 is required to begin an intermediate glass processing operation.

Figure 2
Flow Diagram for Certain Low Volume Intermediate Glass Processors



has operations in Binghamton, N.Y., and Berlin, N.J.—has been able to accomplish this growth through the use of a fleet of trucks that backhauls waste glass to the processing plant after delivering cullet to glass manufacturers. The facility appears to be centrally located between suppliers of waste glass and users. REI processes more than 3,000 tons per month, operating six days a week. On the other hand, ABC requires seven days a week to process 300 tons per month. ABC utilizes such labor intensive processes as handfeeding its hammermill. Cullet for its plant is transported more than 200 miles to the Owens-Illinois plant in Portland, and the trucks return empty.

Trends

Increasing numbers of intermediate glass processors throughout the U.S. are playing an important role as middlemen between suppliers of source-separated glass containers and users of cullet. These processors provide marketing and transportation services to the suppliers, while assuring quality control products for the users.

The location of glass container plants and the high cost of transportation help dictate where intermediate processing can be viable.

It is difficult to predict how extensive future growth will be for independent processors. For the most part, this type of enterprise appears to be only marginally profitable and is not conducive to competition within an area of operation. The location of glass container plants and the high cost of transportation also help dictate where intermediate processing can be viable.

On the other hand, the quality and quantity of cullet provided by the IGP is commanding higher prices from glass manufacturers. Improved operational and transportation network efficiencies by these processors mean that greater distances can be covered economically.

From a supply standpoint, it can be expected that tonnages will increase due to a number of factors: growing concerns about costs and landfill siting for municipal solid waste; conservation and environmental goals for increased source separation and recycling; new capital-intensive resource recovery systems with mechanical recovery of glass (of course, IGP's will not deal with this source); etc. As for the demand side of the picture, many glass container plants will probably use larger percentages of outside-plant cullet in glass furnace mixes, although operational conditions and needs of individual plants vary. If uses can be found for container cullet in other types of glass manufacturing and, perhaps, in secondary applications, the demand would be increased and a broader geographical spread of users could be found. This would encourage a more widespread practice of source separation, intermediate processing and waste glass utilization.

This article was prepared by David B. Weiss, NCRR research engineer.

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CODISPOSAL

A Practical Approach to Integrated Waste Management

The concept of codisposal is based on the idea that the simultaneous disposal of solid waste and wastewater treatment sludges can be more efficient under proper circumstances than two separate disposal activities. Interest in the concept has increased as the volume of sludge has grown with more widespread sewage treatment, and as landfill has become a less obvious disposal method in many areas for both solid waste and sludge. At present, it appears that codisposal has entered a new, more promising stage. A number of recent events mark this passage:

- The U.S. Environmental Protection Agency's (EPA) decision to provide Construction Grant funding to the wastewater treatment project now being planned in Memphis, Tenn., which will utilize refuse-derived fuel (RDF) as a fuel in multiple-hearth pyrolysis of sludge. (This is not the first codisposal project to receive EPA funding; projects in Duluth, Minn., and Glen Cove, N.Y., have also received grants. However, the Memphis decision is distinctive because it represents EPA's acceptance of this technology.)
- EPA's recent publication of a draft memorandum[1] analyzing funding policy options for multiple purpose projects such as codisposal. (These options generally make codisposal more attractive than under previous funding schemes.)
- EPA's forthcoming regulations for hazardous waste disposal under the Resource Conservation and Recovery Act of 1976 (RCRA). (It is expected that land disposal of sludge will be more closely controlled than at present. Under other legislation, deadlines have already been set to stop ocean dumping of sludge.)

Table I presents a listing of communities currently committed to codisposal projects. In addition, of the 62 resource recovery Urban Grant applications funded by EPA this year, four are pursuing codisposal as their primary approach; many of the other recipients are investigating it as an alternative. With this level of interest, it is appropriate to undertake a brief review of the concept as it stands today.

This article was prepared for the *NCRR Bulletin* by Richard A. Baldwin, Thomas M. Barnett, and Harvey W. Gershman. The authors are consulting staff in the Washington office of Gordian Associates, Inc.

Technology Overview

Codisposal can be accomplished in various ways, although there are three basic approaches: landfilling, composting, and thermal destruction. Thermal destruction is the focus of this overview, since it is most compatible with resource recovery and affords significant opportunities for avoiding problems associated with land application.

Four methods of thermal destruction appear promising:

- RDF use in multiple-hearth or fluidized-bed sludge incinerators;
- Sludge in MSW incinerators;
- Sludge in MSW dedicated boilers; and
- Sludge in MSW starved-air combustors.

Codisposal in a Multiple-Hearth or Fluidized-Bed Sludge Incinerator

This approach has been the focus of much interest. EPA has funded a demonstration project in Contra Costa County, Calif. Major projects are also planned or under construction for Duluth, Minn., and Memphis, Tenn.

For traditional sludge disposal, multiple-hearth and fluidized-bed furnaces burn oil to dry the dewatered sludge (20-40 percent solids) to the point of selfsustaining combustion. For codisposal, the system is essentially the same except that processed municipal solid waste (MSW) is used as the fuel. Raw MSW must be passed through an RDF processing train to produce three-to-six-inch particles. Processed refuse and dewatered sludge can be mixed prior to injection or fed separately into the furnace. The rate of mixing depends upon moisture content, heat value and other variables; but it appears that 2.5 or 3 parts RDF to one part sludge will work well.

If incoming air is reduced below stoichiometric proportions, the incinerator will operate as a pyrolysis reactor. The resulting gas has a heat value of up to 130 BTU per standard dry cubic foot (sdcf) and is suitable for combustion for energy recovery. This mode of multiple-hearth furnace operation has been pilot tested for one month at the Contra Costa project.

Fluidized-bed codisposal has also been successfully demonstrated at the Black Clawson hydra-pulping facility in Franklin, Ohio. Start-up and shakedown is about to begin on a 400 ton-per-day (TPD) fluid-bed facility of this type in Duluth.

Existing multiple-hearth and fluidized-bed furnaces can be retrofitted to accommodate RDF.

Existing multiple-hearth furnaces (MHF) and fluidized-bed furnaces (FBF) can be retrofitted to accommodate RDF. The feed system must be adapted to RDF and the air emissions equipment must be modified to handle different and increased off-gas volumes. The Contra Costa facility was a retrofit application and several major MHF and FBF manufacturers (notably Nichols, Envirotech and Dorr-Oliver) feel that their furnaces can be adapted to codisposal.

Sludge in MSW Waterwall Combustior Furnace

Experience in Europe has shown that coincineration in a waterwall furnace is feasible. Preprocessing of the MSW is not required. Sludge can be pumped or trucked to the incinerator site as a liquid, then dewatered (20 percent solids) and fed into a steam-heated drier. At 85 percent solids, it is then fired in the combustion chamber. According to one manufacturer, this process can effect a net energy gain.

The refuse-to-sludge ratio in this case is influenced more by practical and economic, rather than technical, considerations. Sludge drying is usually a net consumer of steam, and reductions in steam output from any large scale resource recovery facility would have to be carefully planned. Only ratios greater than 10 parts of MSW to one part of sludge have substantial energy recovery potential.

Sludge in MSW Dedicated Boilers

Dedicated boiler systems, where incoming MSW is processed into RDF prior to combustion, are gaining popularity as an MSW disposal option. Large new facilities are being constructed in Akron, Ohio, and Niagara Falls, N.Y. While neither of these facilities currently plans to include sludge disposal, dedicated boilers are definitely compatible with codisposal. The most significant differences between this system and the waterwall system lie in the higher costs and greater revenue potential of the dedicated boiler, both of which relate to the higher energy transfer efficiencies of the semi-suspension combustion unit.

Sludge in MSW Starved-Air Combustors

This approach differs from other waste incinerators options in both scale and technology. According to systems vendors, codisposal is viable. However, one consideration for codisposal in modular starved-air combustor systems is that the fairly low energy transfer efficiency of the combustion unit would lower the optimum refuse-to-sludge ratio. Thus, the amount of energy left over from sludge drying would also be less than for waterwall systems. In Auburn, Maine, a 150 TPD system of this type is being considered. A design feasibility study, currently underway, will determine whether the concept will be included in the final design and construction.

Experience in Europe has shown that coincineration in a waterwall furnace is feasible.

From a technological standpoint, thermal codisposal is generally a viable process, although it cannot yet be considered ready for an off-the-shelf label. Many of the remaining questions concerning codisposal technology are based on environmental issues. The primary concerns are potential problems with air emission and leachate from the landfilling of combustion residue materials.

Economics of Codisposal

By combining disposal operations, codisposal also integrates the economics of resource recovery and wastewater treatment. In resource recovery, the economic objective is to maximize net project revenues, where the costs of constructing, owning and operating the facility are offset by revenues available from tipping fees, sale of recovered materials and sale of recovered energy. The "bottom line" should be a financially self-sufficient facility with a tipping fee that is lower than any other feasible alternative. In general, these facilities must produce sufficient financial returns to liquidate their entire capital debt.

Wastewater treatment, on the other hand, generally produces no revenues apart from the user charges levied within the system. These charges must be sufficient to cover all current costs, as well as to repay the local share of debt incurred to construct the system. The federal share of capital costs need not be repaid, as grant funds are available from EPA to cover a sizeable part of the costs of treatment plant planning, design and construction.

Depending on the scale of the project, codisposal can bring together the revenues available from materials/energy recovery and the grant financing available for waste-water treatment projects. For example, where RDF is used as fuel in a multiple-hearth or fluid-bed sludge incinerator, it is possible that the wastewater treatment plant can generate enough energy to supply some of its own needs or even be an energy exporter. At the least, using RDF as a fuel can help to avoid the rapid increase in fossil fuel costs for sludge incineration.

Where sludge is to be burned in a large-scale MSW resource recovery facility, the service of sludge disposal becomes another source of revenue to the facility, as does the sale of steam to dry the sludge. Further, the capital costs of sludge transport, dewatering and drying can be borne in part by EPA grant funding.

Relative Costs of Codisposal

In codisposal, the same objective is sought by both the solid waste and the sewage treatment agencies: to carry out their disposal operations at the lowest cost. Unfortunately, there is a lack of empirical cost data for planning and comparing codisposal options. However, the findings of several recent studies indicate that codisposal costs are generally competitive with the combined costs of comparable separate single purpose systems and, under some conditions, could be lower. A 1979 General Accounting Office report[2] summarizes several previous sites specific studies that show codisposal to be more economical than alternative single purpose options. In research carried out by Gordian Associates Inc., for EPA, the generalized costs of single purpose disposal and codisposal were compared for equivalent weights of total solids. **Table II** shows a summary of this comparison. Codisposal cost estimates are generally lower than comparable separate handling options. These comparisons are based on cost data derived from secondary sources and accepted cost estimating methods. As such, they do not necessarily reflect the outcome of any site-specific cost comparison.

Until more empirical data becomes available, it is impossible to make a

general statement as to the economic attractiveness of codisposal. However, studies to date show codisposal to be worth considering in any situation where landfill options are not available for sludge and solid waste.

Financing

Capital financing for wastewater collection and treatment is a combination of federal, state and local public funding, plus private contributions for specific elements of the system. For treatment works and major interceptor sewers, eligible capital items may be 75 percent funded by a federal grant under the Clean Water Act.[1] The remaining 25 percent is provided by state and local sources in shares that vary from state to state. The state share may be provided as a grant or as a low-interest loan, while the local share is in most cases raised by general obligation or revenue bonding. For collection facilities other than major interceptors, funds are also provided locally from bonded indebtedness or from assessments against individual property owners.

Solid waste management activities are financed in a different manner. The most important difference is that limited federal funds are available only for project planning; none are available for capital financing. In addition, there is a greater presence of private risk capital in application to both collection and disposal activities. Thus, the potential capital funding mix includes local public funds, perhaps augmented with state-level funding assistance, and private funds from entrepreneurs operating solid waste handling concerns.

In cases where codisposal appears attractive on the basis of total costs or cost per ton of waste handled, planners will face problems in allocation of capital and operating costs. Each of these cost categories is made up of three components: (1) the costs attributable solely to solid waste handling activities; (2) the costs attributable solely to sludge handling; and (3) the joint costs, which refer to those parts of the process that handle both sludge and solid waste.

The two direct cost components are relatively easy to account for using common sense decision rules. For example, what is the purpose of each process step? If its purpose is to handle one waste stream exclusively, then categorizing the cost of that step is not difficult. Another role might be to ask whether the project depends on the process step in question. In a project using RDF as fuel for a multiple-hearth furnace, it seems clear that the tipping floor is solely a solid waste process necessity, one that would be required for any high-technology MSW facility. Similarly, materials recovery could be classified as related primarily to solid waste management. RDF processing and storage, however, are required in order to have the fuel the facility will use. This step in the process would be a joint cost.

Each project to date uses a unique process train, so no clear-cut set of cost categories has been developed. Nevertheless, if two separate agencies exist, or if the project serves two different populations, the costs must be allocated between the two so that capital financing proportions and user charges can be de-

Table I: Planned

Location and Description	Projected Cost (millions)	Status
Ansonia, Conn. About 40 TPD of solid waste and 12.5 TPD dry sludge have been combusted in a retrofitted, refractory lined incinerator. The sludge is dried by passing it through a spray drier which uses furnace flue gases.		Stopped operations in 1977 following a shredder explosion. Air pollution equipment being upgraded at this time.
Auburn, Maine. A 150 TPD starved-air combustion system is being designed to accept 10 TPD of dry sludge from the area sewage treatment operation. The sludge will be received and handled separately for controlled feeding and drying prior to being coincinerated. The facility is to produce steam for sale to local industry for process use.	$ 3.5	Groundbreaking scheduled for August 1979. Inclusion of sludge subject to results of ongoing design study by Consumat and City engineering consultants.
Contra Costa County, Calif. About 1,200 TPD of garbage will be processed into 600 TPD of RDF and burned with 96 TPD of sludge in multiple hearth incinerators in the pyrolysis mode.	$50.0	Facility plan completed.
Duluth, Minn. About 70 TPD of dry sludge will be burned in a fluidized bed sludge incinerator using 160 TPD of RDF as the auxiliary fuel source. Because the amount of RDF produced will exceed the amount required for sludge burning, other markets for the excess RDF are being sought. Ferrous metals will be recovered and steam will be used to run the processing facility.	$21.7	Under construction. Expected to start up in Fall 1979.

Depending on the scale of the project, codisposal can bring together the revenues available from materials/energy recovery and the grant financing available for wastewater treatment projects.

Codisposal Facilities

Location and Description	Projected Cost (millions)	Status
Glen Cove, N.Y. About 175 TPD of garbage and 25 TPD of sludge (20 percent solids) will be coburned in a garbage incinerator. Waste heat from the incinerator will be used to produce power for the waste-water treatment plant. Ferrous metals will be recovered from the ash.	$10.0	Construction delayed pending further EPA reviews.
Harrisburg, Pa. Some steam from an existing garbage-burning waterwall incinerator will be used to dry sludge to 15 percent solids. The sludge will then be burned with the garbage. The incinerator can process 720 TPD of garbage and 49 TPD of sludge. Ferrous metals recovery is planned.	$ 4.7	Under construction. Estimated completion in October 1979.
Memphis, Tenn. RDF production with ferrous metals recovery. RDF and sludge will be burned in multiple hearth incinerators in the pyrolysis mode. Steam will be sold to nearby industries. The plant capacity is 2,400 TPD of garbage and 1,225 TPD of sludge.	$140.0	Independent engineering and economic review being undertaken by city. Final decision to proceed to be made in Fall 1979.
Wilmington, Del. About 70 TPD of dry sewage sludge will be composted with RDF. Only a fraction of the 1000 TPD of MSW processed will be composted, and the remainder will be burned in a dedicated boiler. The project is being designed and constructed by Raytheon Service Co.	$51	Ground breaking is expected in September 1979.

Source: General Accounting Office codisposal report and personal communication.

veloped. Capital cost allocation is particularly important in establishing the part of the project funds that can be supported by an EPA Construction Grant.

EPA Multiple Purpose Project Funding

Both the Resource Conservation and Recovery Act and the Clean Water Act explicitly encourage integrated waste disposal. For all projects to date, EPA has provided funds under a multiple purpose funding policy developed in 1976 to address projects in combined sewer overflow, flood control, wastewater reclamation-reuse and codisposal. The 1976 policy was based on complex calculations to prorate joint benefits and costs. It received criticism for effectively reducing the federal share if a project accomplished multiple purposes, thereby favoring single purpose projects. Project funding under the 1976 policy has ranged from 75 percent of all costs in Duluth to about 40 percent of total project cost in Glen Cove.

EPA recently issued a revised policy document for public comment. It offers seven policy alternatives, most of which would result in more favorable treatment for codisposal projects. Under four of the seven policy options, the grant eligible portion of a codisposal project would be 115 percent of the ratio of the most cost-effective, single-purpose sludge disposal option to the cost of the codisposal project. All costs are calculated as the present worth of all capital and operating costs. In some cases, applying the formula may result in a grant eligible amount for codisposal which is less than the sludge-only option's capital cost. If this occurs, a minimum eligibility figure (115 percent of the least costly sludge disposal option's capital cost) would be used. Using this approach, the grant eligible amount for a codisposal project would be significantly higher than under the current prorated formula.

Codisposal cost estimates are generally lower than comparable separate handling options.

One difficulty in EPA's draft policy analysis is that revenues are not deducted from overall project costs in determining the "present worth cost" to be used in funding calculations. EPA's logic is that projects with any nonmonetary benefits, which cannot be given a dollar value, would be disadvantaged. However, the revenues of codisposal are typically an important aspect of financial feasibility. If they are disregarded in funding decisions, it means that high technology codisposal options will be seen as more costly than they actually are.

Institutional Factors Affecting Codisposal

Along with technological and economic factors, a third distinct family of institutional considerations is equally important. "Institutional" refers to the complex legal, organizational and administrative factors relating to waste water and solid waste management. These factors, which can become important if a project is technically and economically feasible, fall into three main groups: organizational differences, planning constraints and legal issues.

Organizational Differences

Important differences exist between water and solid waste management programs because solid waste and water quality management have not developed in parallel. Water quality management programs originated as a local public

health concern; emphasis shifted later to improvement of the nation's waterways. Particular concern over problems of sludge disposal has emerged recently as a result of continual growth of nationwide treatment capacity.

Municipal wastewater treatment has also evolved as an expensive, publicly-owned function. Widespread secondary treatment requires increasingly costly facilities. To construct these, a sizeable federal grant program was established.[4] Grants under the Federal Water Pollution Control Act are made available to public agencies, with rigorous corollary requirements for planning and management. The effect of these program requirements has been the creation of municipal or regional public bodies, vested with considerable centralized responsibility and authority.

Both RCRA and the Clean Water Act explicitly encourage integrated waste disposal.

Solid waste management, on the other hand, has progressed along different lines. Waste has traditionally been handled by the individual waste generator—the household, factory, institution, etc. Further, whereas the focus of wastewater treatment is on effluent and stream quality, the focus of solid waste management has been mainly on removal of the waste to a dump or landfill.

With growing population levels and densities, these functions in larger cities and towns had to be performed in some organized manner. This has led to the growth of private waste hauling and disposal industries in the U.S. Unlike wastewater treatment, the different components of solid waste management (*i.e.*, collection, transport, processing, storage, disposal) can be handled by different concerns, and in most places in the U.S. have never been handled by one authority.

A grant program similar to that established for wastewater treatment does not exist for solid waste management, due in part to the far lower levels of capitalization required and to the potential for interference with private operations. Consequently, solid waste management has developed far less centralized activity than wastewater programs. The various planning and financing functions are instead vested in different groups, some public and some private.

Planning Constraints

Wastewater and solid waste management planning activities are guided by different requirements and objectives. For example, both programs are aimed at cost minimization. But since federal grants are available for a significant proportion of capital costs, sewage treatment planning emphasizes minimization of locally supported operating costs, often substituting capital items in favor of added operating expense. On the other hand, most solid waste project costs must be borne locally, so that the emphasis has typically been on the lowest cost mix of capital and other factors of production, often resulting in labor- or land-intensive processes.

This can be a significant barrier, in that codisposal largely means capital intensity in solid waste handling. The planning process becomes considerably more complex than that required for typical operations, such as landfilling. This additional complexity creates an immediate demand for greater human, technical and data resources, as well as for greater funding levels.

A further problem arises from differences in the geography of solid waste and wastewater management concerns. Not only are wastewater functions planned according to hydrologic boundaries as opposed to municipal ones, but treatment plants are also typically sited downstream from population, near the planned outfall location. Sites available to meet these water-related criteria may not be well located for solid waste handling. The viable scales of operation also do not lend themselves in all cases to servicing the same geographic area or population base. To some extent (*e.g.*, joint siting and the need to organize sewage collection for maximum gravity flow), these are practical problems that can be worked out during planning once a commitment is made to consider codisposal. However, they also represent real institutional issues in that the designation of joint service area boundaries requires an overview level of planning that is not usually found in the individual plans of two separate organizations.

Another major organizational barrier to planning lies in the difference

Table II

Comparison of Annual Costs[a] of Major Thermal Codisposal Options *vs* Comparable Single Purpose Alternatives

Codisposal Option	Ratio MSW:MSS[b]	Codisposal Costs	Single Purpose MSW Costs	Single Purpose MSS Costs	Combined Single Purpose Costs
MHF/FBF	250:100	5,250	1,125[c]	4,295[d]	5,420
Waterwall	1000:100	5,600	2,100	4,295[d]	6,395
Dedicated Boiler	1000:100	6,212	2,700	4,295[d]	6,995
Modular Incinerator	100:10	636	330	747[d]	1,077
Pyrolysis	1000:100	6,794	4,200	4,295[d]	8,495

Notes:

a. Costs are shown in thousands of 1978 dollars and include capital amortization and debt service. Revenues from recovered energy and materials have been subtracted where applicable.

b. Ratios are in dry weights of MSW (Municipal Solid Waste) and MSS (Municipal Sewage Sludge).

c. Based on a full materials recovery fluff RDF system.

d. Based on a filter press, MHF incineration system.

Source: *Codisposal of Municipal Solid Waste and Sewage Sludge: An Analysis of Constraints*, Gordian Associates Inc. – an unpublished report prepared for U.S. EPA in 1978.

between a completely public wastewater program and a partly public, partly private solid waste activity. This interferes with planning in that private operations have no incentive to plan or operate jointly. Further, public agency planning that has any impact on local private entrepreneurs must be carried out with attention to securing their support and preserving their livelihood.

Consequently, meshing the planning activities of wastewater and solid waste will involve careful coordination at local, state and federal levels. Of these three levels, the local planning agencies are the most important, for two reasons: (1) the motivation for considering codisposal should originate locally; and (2) in the absence of strong solid waste funding programs at both state and federal levels, there may be insufficient staff or incentives to accomplish program coordination. In general, these differences point to joint planning on a regional or areawide level as the appropriate approach to problem resolution.

Legal Issues

Control of the solid waste stream is a critical element in planning codisposal projects. In some municipalities, the collection and disposal of solid waste is a public function; but almost twice as many U.S. cities have their residential refuse collected by private collection firms.[5] In these cases, waste control can be achieved either by offering a lower tipping fee at the public facility or by legislating public control of the municipal waste stream. Flow control is currently the more prevalent method for legislating waste control. It requires solid waste to be delivered to the municipality's facility by private refuse haulers. Such an arrangement has thus far been legislated by the State of Florida; the City of Akron, Ohio; Monroe County, N.Y.; Jefferson County (Louisville), Ky.; and the Western Lake Superior Sanitary District in Duluth, Minn.

Another method, which has been legislated in the U.S. only by the State of Wisconsin, is actual municipal ownership of the waste stream. Waste control legislation in effect assures the municipality's access to a steady supply of solid waste for the life of its processing facility.

In concept, codisposal is an attractive waste management option.

The waste control issue is presently being challenged in Federal District Court in the case of *Glenwillow Landfill, Inc., et al.* v. *City of Akron et al.*[6] The City of Akron, which enacted flow control legislation in order to facilitate the establishment of an areawide solid waste resource recovery facility, is being challenged by Glenwillow Landfill, Inc., a private landfill operator, as to the constitutionality of its law. A decision is expected later this year.

The above institutional issues have repeatedly proven to be real barriers to the implementation of codisposal. However, the importance of institutional factors depends on whether a project can be seen as technically or economically feasible to begin with.

Summary

In concept, codisposal is an attractive waste management option. Its technology is viable, although it remains to be fully proven and there are several unanswered questions regarding air emissions and leachate from residue disposal. Data available at this time indicate that in those cases where solid waste and wastewater management planning must turn toward high technology disposal methods, codisposal should be included as a major alternative. It appears that codisposal is at least comparable in cost to separate waste handling options. Its economic attractiveness will likely be further enhanced by EPA's forthcoming policies for multiple purpose project funding. Planning and implementation of a codisposal project must be carried out carefully, in light of institutional problems that arise in meshing two dissimilar waste disposal programs. Most of these difficulties can be dealt with by establishing a strong, integrated, local or regional planning program. If these barriers can be overcome, codisposal offers an opportunity to combine the energy and environmental benefits of resource recovery with the financial advantages of wastewater treatment capital funding.

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RESOURCE RECOVERY ACTIVITIES

For several years, NCRR has been tracking resource recovery activities in the U.S. and publishing periodic summaries. Because of the growing interest in systems to moderate solid waste disposal problems while recovering recyclables and energy products—plus a growing number of projects being undertaken—we have adapted the listing to a regular feature in every other issue of the *NCRR Bulletin*.

The listing is broken down into four segments for ease of review: (1) capital-intensive energy and materials recovery facilities either built, operating, in shakedown or under construction; (2) smaller, controlled-air or modular combustion projects; (3) methane recovery from sanitary landfills projects; and (4) jurisdictions where commitments have been reported to undertake resource recovery projects.

Although every effort has been made to make this report complete and up-to-date, the dynamics of resource recovery are such that the status of projects can change at any time. For clarification or additional information, therefore, we suggest that you write directly to the contacts listed.

We are grateful for the review and input by the various project representatives, as well as that from local, state and federal officials, particularly the U.S. Environmental Protection Agency and the U.S. Department of Energy.

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Akron, Ohio	City; Glaus, Pyle, Schomer, Burns & De Haven; Ruhlin Const. Co.; Babcock & Wilcox Co. (boiler supplier); Teledyne National (operator)	Shredding; air classification; magnetic separation; burning RDF in semi-suspension, stoker-grate boiler	Steam for urban and industrial heating and cooling; ferrous metals	1000 TPD	46[a]	In shakedown; fully operational by Jan. 1980	Roy Ray Dir. of Finance 208 Municipal Bldg. 166 South High St. Akron, Ohio 44308
Albany, N.Y.	City and 10 nearby communities; Smith & Mahoney (designer/project mgr.)	Shredding; magnetic separation; burning in semi-suspension, stoker-grate boiler; nonferrous recovery from boiler ash	RDF; ferrous metals; steam for urban heating and cooling; nonferrous metals	750 TPD	22	Construction 60% complete; operational in early 1980; steam generating facility operational in 1981	Patrick Mahoney Smith & Mahoney 40 Steuben St. Albany, N.Y. 12207
Ames, Iowa	City; Gibbs, Hill, Durham & Richardson, Inc. (designer)	Baling waste paper; shredding; magnetic separation; air classification; screening; other mechanical separation	Refuse-derived fuel for use by utility; baled paper; ferrous metals; aluminum; other nonferrous metals	200 TPD 50 TPH	6.19[b]	Operational since 1975	Arnold Chantland, Dir. Dept. of Public Works City Hall 5th and Kellog St. Ames, Iowa 50010
Baltimore, Md.*	City; EPA	Formerly Landgard* process, now modified significantly by Baltimore City; includes shredding, pyrolysis, steam production, water quenching	Steam for use by city utility	600 TPD	30.1	Plant operating 24 hrs./day, 6 days/week	Ed May Baltimore City Pyrolysis Plant 1800 Annapolis Rd. Baltimore, Md. 21230

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Baltimore County, Md.	County; Maryland Environmental Service; Teledyne National (designer/operator)	Shredding; air classification; magnetic separation	RDF; ferrous metals; glass for secondary products; aluminum	600-1500 TPD	8.4	Operational; recovering ferrous metals and producing secondary shredded and pelletized RDF; glass and aluminum recovery operational	Kenneth Cramer Teledyne National 117 Church Lane Cockeysville, Md. 21030
Braintree, Mass.	City (owner/operator); Camp, Dresser & McKee, Inc. (designer)	Mass burning	Steam; producing ½ million lbs/day; selling ½ of steam produced to Art & Leather Co.	250 TPD	$2.8	Operational since 1971	Edward Courchene, Supt. Braintree Thermal Waste Reduction Center Ivory Street, Braintree, Mass. 02184
Bridgeport, Conn.	Conn. Resources Recovery Authority; Occidental Petroleum Corp. and Combustion Equipment Assoc. (designer/operator)	Shredding; magnetic separation; air classification; froth flotation	Eco-Fuel II® (powdered fuel) for use in utility boiler; ferrous metals; nonferrous metals; glass	1800 TPD	53[c]	Construction complete; startup has begun. Eco-Fuel II® in production since May 1979	Ed Kelly, Mgr. Public Information Combustion Equipment Assoc. 555 Madison Ave. New York, N.Y. 10022
Chicago, Ill. (Northwest Incinerator)	City; Metcalf & Eddy, Inc. (designer)	Waterwall combustion	Steam for Brach Candy Co.; ferrous metals	1600 TPD	23	Operational since 1971; steam delivery expected to be on line in 1980	Emil Nigro Supervising Engineer Bureau of Sanitation Room 704—City Hall Chicago, Ill. 60602
Chicago, Ill. (Southwest Supplementary Fuel Processing Facility)	City; Ralph M. Parsons Company and Consoer, Townsend & Assoc. (designers)	Shredding; air classification; magnetic separation	RDF for use by utility; ferrous metals	1000 TPD	19[d]	Operating at 50% capacity; gradual production increase planned	(Same as previous listing)
Columbus, Ohio	City; Alden E. Stilson Assoc. (designer)	Shredding; magnetic separation; burning of shredded refuse with supplemental coal in semi-suspension, stoker-grate boiler to produce steam; generation of electricity from steam	Electricity for City customers	1200 TPD	118	Equipment being purchased; site preparation began July 1979; operational in late 1981	Thomas DeVoe, Dir. Dept. of Public Services 90 West Broad St. Columbus, Ohio 43215
Dade County, Fla.	County; Black Clawson/Parsons & Whittemore, Inc. (designer)	Hydrasposal™ (wet pulping); magnetic and other mechanical separation)	Steam for utility to produce electricity; glass; aluminum; ferrous metals	3000 TPD	165[e]	Contracts signed between County, B&W and Fla. Power & Light; pollution control bonds sold by state; construction began April 1979; completion scheduled for April 1981	Dennis Carter Asst. County Manager Room 911 Dade County Courthouse 73 W. Flagler St. Miami, Fla. 33130
Detroit, Mich.	City	Shredding; air classification; magnetic separation	Steam and/or electricity for use by Detroit Edison; ferrous metals	3000 TPD	125	Negotiating with Combustion Engineering, Inc./Waste Resources Corp.; prior to contract signing; steam to be purchased by Detroit Edison; environmental impact statement being prepared	Michael Brinker Environmental Protection and Maint. Dept. City of Detroit City-County Bldg., Room 513 Detroit, Mich. 48226

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Duluth, Minn.	Western Lake Superior Sanitary District (operator); Consoer, Townsend & Assoc. (engineer)	Shredding; magnetic separation; air classification; secondary shredding; fluidized bed incineration of RDF and sludge	RDF; ferrous metals; steam for heating and cooling of plant and to run process equipment	400 TPD of MSW, 340 TPD of 30% solids sewage sludge	19[f]	Under construction; operational in Sept. 1979	John Klaers Western Lake Superior Sanitary Dist. 27th Ave. West & The Waterfront Duluth, Minn. 55806
East Bridgewater, Mass.	City of Brockton and nearby towns; Combustion Equipment Assoc.; East Bridgewater Assoc.	Shredding; air classification; magnetic separation; other mechanical separation	Eco-Fuel II® for industrial boiler; ferrous metals	550 TPD being processed	10-12	Operational since 1977; plant has served as pilot operation for production of Eco-Fuel II®	(Same as Bridgeport, Conn.)
Glen Cove, N.Y.	City (owner/operator); William F. Cosulich and W.F. Frank (designers)	Mass burning in stoker-fired furnace with vacuum filtered sewage sludge	Steam for electricity for use at sewage plant	225 TPD	20 ($8 M for mass burning unit; $12 M for sewage plant)	Sewage plant under construction; bids go out on Oct. 1, 1979 for construction of incinerator unit	Ernest Pascucci, Commissioner Dept. of Public Works City Hall, Bridge St. Glen Cove, N.Y. 11542
Hampton, Va.	City, NASA Langley Research Center, U.S. Air Force at Langley Field, J.M. Kenith Co. (designer/builder)	Mass burning	Steam for use by NASA Langley Research Center	200 TPD	9.4	Foundation, precipitator stacks installed; boilers being installed	Frank H. Miller, Jr. Dir. of Public Works Hampton, Va. 23669
Harrisburg, Pa.	City; Gannett, Fleming, Corddry and Carpenter, Inc. (designer)	Waterwall combustion; bulky waste shredding (steam driven); magnetic separation; sewage sludge burning	Steam for utility-owned district heating system and for City-owned sludge drying system; ferrous metals	720 TPD	8.3	Operational since Oct. 1972; steam sale to utility began Dec. 1978; sludge drying facility to be completed by Fall 1979	Paul W. Bricker Gannett, Fleming, Corddry and Carpenter, Inc. P.O. Box 1963 Harrisburg, Pa. 17105
Hempstead, N.Y.	Town; Hempstead Resource Recovery Corp. (Div. of Black Clawson/Parsons & Whittemore, Inc.) (owner/operator)	Hydrasposal™ (wet pulping); magnetic and mechanical separation; burning of RDF product in air-swept spout spreader stoker boilers	Electricity from utility-owned turbine generators; color-sorted glass; aluminum; ferrous metals	2000 TPD (150 TPH)	73	In shakedown	D.C. Cullingham Vice Pres. & Gen. Mgr. Hempstead Resources Recovery Corp. P.O. Box 4014 Roosevelt Field Station Garden City East, N.Y. 11530
Lakeland, Fla.	City (operator and joint owner with Orlando Utility Commission); C.T. Main, Inc.; (designer)	Shredding; magnetic separation; burning RDF with coal	Steam to produce electricity for use by Orlando Utility Commission; ferrous metals	300 TPD	186	Equipment purchased; construction begun	Claude Hiers Supt. of Industrial Engineering & Business Affairs Box 368 Lakeland, Fla. 33802
Lane County, Ore.	County; Allis-Chalmers Corp. (designer); Western Waste Corp. (operator)	Shredding; air classification; magnetic separation	RDF; ferrous metals	500 TPD	2.1[g]	In shakedown, operational in Jan. 1980	Mike Turner Adm. Analyst Lane County Solid Waste Mgt. Div. Environmental Mgt. Dept. 125 East 8th Ave. Eugene, Ore. 97401
Madison, Wis.	City and M.L. Smith Environmental (designer); Madison Gas & Electric Co. (RDF user)	Shredding; magnetic separation; separation of combustibles and non-combustibles; secondary shredding air swept	RDF for use by Madison Gas & Electric Co.; ferrous metals	400 TPD (max.) (200 TPD being processed)	2.5[h]	Process plant is operational; test firing RDF	Gary Boley Div. of Engineering Room 115 City-County Bldg. Madison, Wis. 53709

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Milwaukee, Wis.	City; (to expand to surrounding Milwaukee County areas); Americology Div. of American Can Co. (owner/operator); Bechtel, Inc. (designer)	Shredding; air classification; magnetic and other mechanical separation	RDF for use by utility; bundled paper and corrugated; ferrous metals; aluminum; glassy aggregate	1600 TPD	18 (Plus 4.2 at Wisconsin Electric Power Co.)	Operating daily at less than design capacity since March 1977. $4.6 million production improvement program started May 1979; utility RDF test program to be completed Fall 1979	Emanuel Greber Dir. of Marketing Americology Division American Can Co. American Lane Greenwich, Conn. 06830
Monroe County, N.Y.	County (owner); Raytheon Service Co. (designer)	Shredding; air classification; magnetic other mechanical separation; froth flotation	RDF for use by utility; ferrous metals; nonferrous metals; mixed glass	2000 TPD	50.4[1]	Construction complete; startup began Aug. 1979	Howard Christensen Dir. of Solid Waste Department of Public Works 110 Colfax St. Rochester, N.Y. 14606
Nashville, Tenn.	Nashville Thermal Transfer Corp.; I.C. Thomasson & Assoc., Inc. (designer)	Thermal combustion	Steam for urban heating and cooling	400 TPD 7 days per week	24.5	Operational since 1974; recently upgraded two boilers to 530 TPD capacity each	Milton E. Kirkpatrick Exec. V.P. & Gen. Mgr. Nashville Thermal Transfer Corp. 110 First Ave. South Nashville, Tenn. 37201
Newark, N.J.	City; Combustion Equipment Assoc. and Occidental Petroleum Corp. (designers and operators)	Shredding; air classification; magnetic and other separation	Eco-Fuel II® for use by utility; ferrous metals; aluminum	3000 TPD (in 1000 TPD modules, to serve Newark's 700 TPD and surrounding community)	70 (for 3000 TPD) (initially 1000 TPD with a cost of $25 million including fuel user conversion)	Final contract signed 1977; site preparation began in Dec. 1978	(Same as Bridgeport, Conn.)
New Orleans, La.	City; Waste Management, Inc. (owner/operator); National Center for Resource Recovery, Inc. (designer/implementer)	Shredding; air classification; magnetic and other mechanical separation	Ferrous metals; aluminum and other nonferrous metals; glass	700 TPD	9.1[1]	Shredding/landfilling operational; recovering ferrous, aluminum, other nonferrous metals; glass in shakedown	Pat Koloski, Dir. Dept. of Sanitation City Hall New Orleans, LA. 70112
Niagara Falls, N.Y.	Hooker Energy Corp. (Hooker Chemicals & Plastics Corp.) (owner/operator)	Shredding; magnetic separation; burning shredded refuse	Steam and electricity for use by company complex; ferrous metals	2200 TPD	70 (appx.)	Under construction; to be operational in 1980; $22 million worth of equipment on order or on site	Jim Green, Mgr. Public Relations Hooker Energy Corp. 4646 Royal Ave. Niagara Falls, N.Y. 14303
Norfolk, Va. (U.S. Naval Station)	U.S. Navy (owner); Navy Public Works Center (operator); Metcalf & Eddy, Inc. (designer)	Mass burning in waterwall furnace	Steam (40,000 lbs/hr.) for use by Naval Station	360 TPD (two boilers, operated alternately)	2.2	Presently not operating	Causey Simmons Head, Utilities Dept., Navy PUblic Works Center Norfolk, Va. 23511
Oceanside, N.Y.	Township of Hempstead (owner/operator); Charles R. Velzy (designer)	Mass burning in waterwall furnaces	Steam (60,000 lbs/hr.) in-plant use for electricity generation	750 TPD	9	Operational since 1974	Al Alvanese Supt., Sanitation Township of Hempstead 1600 Merrick Merrick, N.Y. 11566
Pinellas County, Fla.	County; Florida Power Corp; Orlando Utilities Commission	Mass burning	Electricity; ferrous metals, aluminum and other nonferrous metals recovered after burning	2000 TPD	95	Negotiations completed for full-service contract with UOP, Inc.; projected to begin construction this year, operational 1983	Don F. Acenbrack, Dir. Solid Waste Dept. of Public Works and Util. Pinellas County 315 Court St. Clearwater, Fla. 33516

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Pompano Beach, Fla.	Waste Mangement, Inc.; U.S. Dept. of Energy; Jacobs Engineering Co. (designer)	Shredding, air classification, magnetic and other mechanical separation, anaerobic digestion of air classified light fraction with sewage sludge	Methane gas	50-100 TPD	3.65	Demonstration plant; operational	Peter J. Ware, Proj. Mgr. Waste Management, Inc. 900 Jorie Blvd. Oak Brook, Ill. 60521
Portsmouth, Va. (Norfolk Naval Shipyard)	U.S. Navy (owner); Navy Public Works Center (operator)	Mass burning in waterwall furnace	Steam (30,000 lbs/hr) for use by facilities at Naval Shipyard	160 TPD (two-80 TPD boilers; operated alternately)	4.5	Operational since 1976	Pete Cananan NAVFAC ENG COM Environmental Quality Division Norfolk, Va. 23511
San Diego, County, Calif.*	County; Occidental Petroleum Corp. (designer/operator)	Shredding, air classification, magnetic and other mechanical separation, froth flotation, pyrolysis	Pyrolytic oil; ferrous and nonferrous metals; glass	200 TPD	EPA—4.2 County—2 Occidental Petroleum 8.3	Demonstration plant; operations suspended after initial testing; further possible funding and modifications being considered	John S. Burke, Dep. Dir. Solid Waste Dept. of Sanitation and Flood Control 5555 Overland Ave. San Diego, Calif. 92123
Saugus, Mass.	Thirteen communities including Saugus and part of northern Boston; RESCO (owner/operator)	Waterwall combustion, magnetic separation	Steam for electrical generation and industrial use; ferrous metals	1200 TPD (two boilers with 600-TPD capacity each)	50	Operational since 1975, expansion being considered	Joseph Ferrante Wheelabrator-Frye, Inc. Liberty Lane Hampton, N.H. 03842
Tacoma, Wash.	City (owner/operator); Boeing Engineering (designer)	Shredding, air classification, magnetic separation	RDF; ferrous metals	500 TPD	2.5[k]	Operational June 1979	Bill Larson, Proj. Mgr. Refuse Utility 740 St. Helens Ave. Room 304 Tacoma, Wash. 98402
Wilmington, Del.*	Delaware Solid Waste Authority; EPA; Raytheon Service Co. (designer)	Shredding, air classification, magnetic and other mechanical separation, froth flotation, aerobic digestion	Ferrous metals; nonferrous metals; glass; RDF; humus	1000 TPD municipal solid waste co-processed with 350 TPD of 20% solids digested sewage sludge	51[l] 9 from EPA OSW; 16 from (EPA, Water Prog.; 6 from State matching grants; remainder from the Authority through sale of revenue bonds	Contract signed Aug. 1978 with Raytheon Service Co.; design of facility is underway; ground breaking expected in Sept. 1979	Pasquale S. Canzano Chief Engineer Delaware Solid Waste Authority P.O. Box 981 Dover, Del 19901

The following localities are either operating or constructing small modular combustion units to produce steam from mass combustion of municipal solid waste:

LOCATION	MANUFACTURER	REPORTED CAPACITY (TPD)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Auburn, Maine	Consumat	150	3.2	Design contract, funded by DOE signed; energy user and operator contracts signed; construction began Aug. 1979	Leo La Rochelle, Dir. Public Works Auburn City Hall 45 Spring St. Auburn, Maine 04210
Blytheville, Ark.	Consumat	75 to be processed	N/A	Temporarily shut down for installation of additional units	Tom Little, Mayor City Hall Blytheville, Ark. 72315

LOCATION	MANUFACTURER	REPORTED CAPACITY (TPD)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Crossville, Tenn	Smokatrol	60	N/A	In shakedown, undergoing modifications	Ed Kimsey, City Mgr. P.O. Drawer 528 Crossville, Tenn. 38555
Dyersburg, Tenn.	Consumat	100	2	Final design phase, scheduled startup in late 1979	David W. Lanier, Mayor P.O. Box 822 Dyersburg, Tenn. 38024
Genesee Township, Mich.	Consumat	100	2.0	Construction 80% complete, to begin operations in Oct. 1979	Hanamunthaiya Marur, Township Engineer 7244 North Genesse Rd. Genesee, Mich. 48437
Groveton, N.H.	Environmental Control Products	30	N/A	Operational since 1975	Rick Coville Groveton Paper Mill, Inc. Groveton, N.H. 03582
Lewisburg, Tenn.	CICO	60	N/A	Under construction, to be in operation in Nov. 1979	J.A. Biggs, Mayor 505 Ellington Pkwy., Rt. 1 Lewisburg, Tenn. 37091
Osceola, Ark.	Consumat	50	N/A	To begin operations in Oct. 1979	R.E. Prewitt, Mayor City Hall Osceola, Ark. 72370
North Little Rock, Ark.	Consumat	100	1.45	Operational since Sept. 1977	Roy Cochran Dir. of Sanitation 1120 Sycamore St. North Little Rock, Ark. 72114
Salem, Va.	Consumat	100	1.9	Operational in 1979	William Paxton, Jr., City Mgr. P.O. Box 869 Salem, Va. 24153
Siloam Springs, Ark.	Consumat	16	.4	Operational since Sept. 1975	Al Varwig, Dir. Sanitation Dept. 410 North Broadway Siloam Springs, Ark. 72761

In addition to the systems listed above, projects are underway to recover methane-containing gas mixtures from sanitary landfills which can be purified to pipeline quality:

LOCATION	KEY PARTICIPANTS	OUTPUT: GAS PRODUCED (MILLION FT³/DAY)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Azusa, Calif.	Azusa Land Reclamation Co. (wholly owned subsidiary of the Southwestern Portland Cement Co.)	Low BTU gas	N/A	Began operations in April 1978	Ralph Rule Southwestern Portland Cement Co. 3055 Wilshire Blvd. Los Angeles, Calif. 90010
Monterey Park, Calif.	Reserve Synthetic Fuels, Inc. (joint venture with Getty Oil Co.)	High BTU gas, 4.0	N/A	Operational August 1979	Frederick C. Rice Reserve Synthetic Fuels, Inc. 2750 Signal Parkway Signal Hill, Calif. 90806
Mountain View, Calif.	City of Mountain View; EPA; Pacific Gas & Electric Co.; Dept. of Energy	High BTU gas, 0.5	0.85	Pilot plant, in shakedown	Max Blanchet Pacific Gas & Elec. Co. 245 Market St. San Francisco, Calif. 94106

LOCATION	KEY PARTICIPANTS	OUTPUT; GAS PRODUCED (MILLION FT³/DAY)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Palos Verdes, Calif.	Reserve Synthetic Fuels, Inc. (joint venture with Getty Oil Co.); Los Angeles County Sanitation District; Southern California Gas Co.	High BTU gas, 75	N/A	Operational since June 1975	same as Monterey Park, Calif.
Staten Island, N.Y. (Fresh Kills Landfill)	New York City Resource Recovery Task Force: Brooklyn Union Gas Co., Inc.; Leonard S. Wegman, Inc.; New York State Energy Research and Development Authority		N/A	Burner test of landfill gas in scaled-down furnace began in Aug. 1979; design of 1000 KW gas-to-electricity plant begun	Anthony Giuliani Brooklyn Union Gas Co., Inc. 195 Montague St. Brooklyn, N.Y. 11201
Sun Valley, Calif. (Sheldon-Arleta Landfill Gas Recovery Project)	City of Los Angeles Departments of Public Works and Water & Power	Low BTU gas, 2.8	2.25	Under construction; operational in Oct. 1979	Mike Miller Sanitary Engineer L.A. Bureau of Sanitation Room 1410, City Hall East Los Angeles, Calif. 90012

The following localities reportedly are in advanced planning stages for resource recovery facilities, have issued Requests for Proposals, or are negotiating with bidders/contractors:

Appleton, Wis.
Beverly, Mass.
Central South Central Conn.
Cincinnati, Ohio
Dubuque, Iowa
Gallatin, Tenn.
Honolulu, Hawaii
Jefferson County, Ky.
Memphis, Tenn.
New York, N.Y.
Norfolk, Va.
North Andover, Mass.
North Hempstead, N.Y.
Orange County, Fla. (Walt Disney World)
Oyster Bay, N.Y.
Peabody, Mass.
Pittsfield, Mass.
Rhode Island (state)
St. Paul, Minn.
San Diego, Calif.
Springfield, Mass. (and surrounding area)
Toledo, Ohio
Tulsa, Okla.
Westchester County, N.Y.

Cost information as reported:

[a] Construction (including $5 million for extensions to existing steam distribution system) $31 million; engineering and construction supervision $1.5 million; interest during construction $5.5 million; contingency, start-up and land costs $1.5 million; fees, underwriting and issuance costs $2.0 million; debt service reserve fund requirement $4.5 million.

[b] Construction and engineering $5.6 million; land $98,000; miscellaneous equipment $165,000; plant start-up in Fall 1975 $322,000.

[c] Total revenues (including bond proceeds and investment income) $54,386,040. Total expenditures: $53,386,040, consisting of the following: project development $3,026,458; bond issue expenses $1,391,413; construction $39,549,771; special capital reserve $5,022,588; debt service $5,395,810 (including main facility and six transfer stations).

[d] Includes design and construction. Funding through G.O. bonds.

[e] Land acquisition, site preparation and recovery plant $145 million; electrical power generating facility $20 million.

[f] Including incineration.

[g] Cost of Phase II of the project, including construction of the resource recovery facility alone and in-plant equipment. Built in conjunction with Phase I which includes central receiving, transfer station and transfer equipment which cost approximately $2.2 million.

[h] For the processing plant.

[i] Total funding authorized by county legislature: $50.4 million, including an $18.5 million grant-in-aid from New York State. D.E.C. funding under the Environmental Quality Bond Act. Includes $28.4 million for construction of the resource recovery facility. Construction of Russell Station RDF handling facility is estimated at $8 million. Balance of funds will be spent for engineering, startup, mobile equipment, etc.

[j] Includes Reduction Module (including landfill) $5.8 million and Recovery Module $3.3 million.

[k] Not including shredder which was already on-site.

[l] Total project costs—$51 million, including $20 million for sludge module.

*Partially funded by the U.S. EPA

NOTE

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Special Feature

RESOURCE RECOVERY ACTIVITIES

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Volume 10, Number 1

NCRR BULLETIN

THE JOURNAL OF RESOURCE RECOVERY

National Center for Resource Recovery, Inc.

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Dr. Rocco A. Petrone
NCRR President

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Whether a resource recovery project succeeds or fails is largely dependent upon decisions made in the early planning stages. This article, based on the recently-published Resource Recovery Decision-Makers Guide, summarizes some important elements for successful project implementation.

8 **Pyrolysis in Baltimore: From 'Failure' to Success**

The Baltimore facility is operating full-time and processing one-fourth of the City's refuse to produce steam . . . despite the fact that the original contractor withdrew three years ago, calling the plant unworkable. This article describes the facility and its operation today.

14 **Technology Review**

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17 **Resource Recovery Activities**

This semiannual listing updates information on resource recovery facilities, controlled-air combustion units, and projects for recovering methane gas from landfills.

RESOURCE RECOVERY ACTIVITIES

National Center for Resource Recovery, Inc.
1211 Connecticut Ave. N.W., Washington, D.C. 20036

For several years, NCRR has been tracking resource recovery activities in the U.S. and publishing periodic summaries. Because of the growing interest in systems to moderate solid waste disposal problems while recovering recyclables and energy products—plus a growing number of projects being undertaken—we have adopted the listing to a regular feature in every other issue of the *NCRR Bulletin*.

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Although every effort has been made to make this report complete and up-to-date, the dynamics of resource recovery are such that the status of projects can change at any time. For clarification or additional information, therefore, we suggest that you write directly to the contacts listed.

We are grateful for the review and input by the various project representatives, as well as that from local, state and federal officials, particularly the U.S. Environmental Protection Agency and the U.S. Department of Energy.

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Akron, Ohio	City; Glaus, Pyle, Schomer, Burns & De Haven; Ruhlin Const. Co.; Babcock & Wilcox Co. (boiler supplier); Teledyne National (operator)	Shredding; air classification; magnetic separation; burning RDF in semi-suspension, stoker-grate boiler	Steam for urban and industrial heating and cooling; ferrous metals	1000 TPD	51[a]	In shakedown; fully operational in March 1980	Dave Chapman 203 Municipal Bldg. 166 South High St. Akron, Ohio 44308
Albany, N.Y.	City and 10 nearby communities; Smith & Mahoney (designer/project mgr.)	Shredding; magnetic separation; burning in semi-suspension, stoker-grate boiler; nonferrous recovery from boiler ash	RDF; ferrous metals; steam for urban heating and cooling; nonferrous metals	750 TPD	22	Construction completed in March 1980; shakedown to begin in April; steam generating facility operational in 1981	Patrick Mahoney Smith & Mahoney 40 Steuben St. Albany, N.Y. 12207
Ames, Iowa	City; Gibbs, Hill, Durham & Richardson, Inc. (designer)	Baling waste paper; shredding; magnetic separation; air classification; screening; other mechanical separation	Refuse-derived fuel for use by utility; baled paper; ferrous metals; aluminum, other nonferrous metals	200 TPD 50 TPH	6.19[b]	Operational since 1975	Arnold Chantland, Dir. Dept. of Public Works City Hall 5th and Kellog St. Ames, Iowa 50010
Baltimore, Md.*	City; EPA	Formerly Landgard® process, now modified significantly by Baltimore City; includes shredding; pyrolysis; steam production; water quenching	Steam for use by city utility	600 TPD	30.1	Plant operating 24 hrs/day, 6 days/week	Ed May Baltimore City Pyrolysis Plant 1800 Annapolis Rd. Baltimore, Md. 21230

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Baltimore County, Md.	County; Maryland Environmental Service; Teledyne National (designer/operator)	Shredding; air classification; magnetic separation	RFD; ferrous metals; glass for secondary products; aluminum	600-1500 TPD	8.4	Operational; recovering ferrous metals and producing secondary shredded and pelletized RDF; glass and aluminum recovery operational	Kenneth Cramer Teledyne National 117 Church Lane Cockeysville, Md. 21030
Braintree, Mass.	City (owner/operator); Camp, Dresser & McKee, Inc. (designer)	Mass burning	Steam; producing ½ million lbs/day; selling ½ of steam produced to Art & Leather Co.	250 TPD	2.8	Operational since 1971	Edward Courchene, Supt. Braintree Thermal Waste Reduction Center Ivory Street Braintree, Mass. 02184
Bridgeport, Conn.	Conn. Resources Recovery Authority; Occidental Petroleum Corp. and Combustion Equipment Assoc. (designer/operator)	Shredding; magnetic separation; air classification; froth flotation	Eco-Fuel II® (Powdered fuel) for use in utility boiler; ferrous metals; nonferrous metals; glass	1800 TPD	53[c]	Construction complete; startup has begun; Eco-Fuel II® in production and being test burned at United Illuminating Co.	Ed Kelly, Dir., Corporate Communications Combustion Equipment Assoc. 555 Madison Ave. New York, N.Y. 10022
Chicago, Ill. (Northwest Incinerator)	City; Metcalf & Eddy, Inc. (designer)	Waterwall combustion	Steam for Brach Candy Co.; ferrous metals	1600 TPD	23	Operational since 1971; steam delivery expected to be on line in 1980	Emil Nigro Supervising Engineer Bureau of Sanitation Room 704—City Hall Chicago, Ill. 60602
Chicago, Ill. (Southwest Supplementary Fuel Processing Facility)	City; Ralph M. Parsons Company and Consoer, Townsend & Assoc. (designers)	Shredding; air classification; magnetic separation	RDF for use by utility; ferrous metals	1000 TPD	19[d]	Temporarily off-stream to review experience to date and evaluate future operations	(Same as previous listing)
Columbus, Ohio	City; Alden E. Stilson Assoc. (designer)	Shredding; magnetic separation; burning of shredded refuse with supplemental coal in semi-suspension, stoker-grate boiler to produce steam; generation of electricity from steam	Electricity for City customers	2000 TPD	127	Equipment being purchased; site preparation began July 1979; piling begun for foundations; operational in late 1981	Henry Bell, Supt. Div. of Electricity 50 W. Gay St. Columbus, OH 43215
Dade County, Fla.	County; Black Clawson/Parsons & Whittemore, Inc. (designer)	Hydrasposal™ (wet pulping); magnetic and other mechanical separation	Steam for utility to produce electricity; glass; aluminum; ferrous metals	3000 TPD	165[e]	Contracts signed between County, P&W and Fla. Power & Light; pollution control bonds sold by state; construction began April 1979; completion scheduled for April 1981	Dennis Carter Asst. County Manager Room 911 Dade County Courthouse 73 W. Flagler St. Miami, Fla. 33130
Detroit, Mich.	City	Shredding; air classification; magnetic separation; dedicated boilers	Steam and/or electricity for use by Detroit Edison; ferrous metals	3000 TPD	125	Negotiating with Combustion Engineering, Inc./Waste Resources Corp., prior to contract signing; steam to be purchased by Detroit Edison; State of Michigan environmental impact statement being prepared	Michael Brinker Dept. of Public Works City of Detroit City-County Bldg., Room 513 Detroit, Mich. 48226

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Duluth, Minn.	Western Lake Superior Sanitary District (operator); Consoer, Townsend & Assoc. (engineer)	Shredding; magnetic separation; air classification; secondary shredding; fluidized bed incineration of RDF and sludge	RDF; ferrous metals; steam for heating and cooling of plant and to run process equipment	400 TPD of MSW; 340 TPD of 20% solids sewage sludge	19[f]	Start-up & shakedown in Spring 1980	John Klaers Western Lake Superior Sanitary Dist. 27th Ave. West & The Waterfront Duluth, Minn. 55806
East Bridgewater, Mass.	City of Brockton and nearby towns; Combustion Equipment Assoc.; East Bridgewater Assoc.	Shredding; air classification; magnetic separation; other mechanical separation	Eco-Fuel II® for industrial boiler; ferrous metals	550 TPD being processed	10-12	Operational since 1977; plant has served as pilot operation for production of Eco-Fuel II®	(Same as Bridgeport, Conn.)
Glen Cove, N.Y.	City (owner/operator); William F. Cosulich and Ernest F.W. Frank (designers)	Mass burning in stoker-fired furnace with vacuum filtered sewage sludge	Steam for electricity for use at sewage plant	225 TPD	32 ($20 M for mass burning unit; $12 M for sewage plant)	Sewage plant and incinerator unit under construction	Mike Grieco Director of Public Works City Hall, Bridge St. Glen Cove, N.Y. 11542
Hampton, Va.	**City; NASA Langley Research Center; U.S. Air Force at Langley Field; J.M.** Kenith Co.,(designer/builder)	Mass burning	Steam for use by NASA Langley Research Center	200 TPD	9.4	Boilers, roofing & siding installed; pumps, motors, & controls being installed	Frank H. Miller, Jr. Dir. of Public Works Hampton, Va. 23669
Harrisburg, Pa.	City; Gannett, Fleming, Corddry and Carpenter, Inc. (designer)	Waterwall combustion; bulky waste shredding (steam driven); magnetic separation; sewage sludge burning	Steam for utility-owned district heating system and for City-owned sludge drying system; ferrous metals	720 TPD	8.3	Operational since Oct. 1972; steam sale to utility began Dec. 1978; sludge drying facility started early 1980	Paul W. Bricker Gannett, Fleming, Corddry and Carpenter, Inc. P.O. Box 1963 Harrisburg, Pa. 17105
Hempstead, N.Y.	Town; Hempstead Resource Recovery Corp. (Div. of Black Clawson/Parsons & Whittemore, Inc.) (owner/operator)	Hydrasposal™ (wet pulping); magnetic and mechanical separation; burning of RDF product in air-swept spout spreader stoker boilers	Electricity from utility-owned turbine generators; color-sorted glass; aluminum; ferrous metals	2000 TPD (150 TPH)	115	In shakedown	D.C. Cullingham V.P. & Gen. Mgr. Hempstead Resources Recovery Corp. P.O. Box 4014 Roosevelt Field Station Garden City East, N.Y. 11530
Lakeland, Fla.	City (operator and joint owner with Orlando Utility Commission); C.T. Main, Inc. (power plant designer); Horner & Shifrin, Inc. (waste processing plant designer)	Shredding; magnetic separation; burning RDF with coal	Steam to produce electricity for use by City of Lakeland and Orlando Utility Commission; ferrous metals	300 TPD	5	Equipment purchased; construction begun; shakedown expected in mid-1981	Claude Hiers Supt. of Industrial Engineering & Business Affairs Box 368 Lakeland, Fla. 33802
Lane County, Ore.	County; Allis-Chalmers Corp. (designer); Western Waste Corp. (operator)	Shredding; air classification; magnetic separation	RDF; ferrous metals	500 TPD	2.1[g]	Off-stream due to explosion in Nov. 1979; to be operational in mid-1980	Mike Turner Adm. Analyst Lane County Solid Waste Mgt. Div. Environmental Mgt. Dept. 125 East 8th Ave. Eugene, Ore. 97401
Madison, Wis.	City and M.L. Smith Environmental (designer); Madison Gas & Electric Co. (RDF user)	Shredding; magnetic separation; separation of combustibles and non-combustibles; secondary shredding air swept	RDF for use by Madison Gas & Electric Co.; ferrous metals	400 TPD (max.) (200 TPD being processed)	2.5[h]	Process plant & boiler firing facility operational	Gary Boley Div. of Engineering Room 115 City-County Bldg. Madison, Wis. 53709

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Milwaukee, Wis.	City; (to expand to surrounding Milwaukee County area); Americology Div. of American Can Co. (owner/operator); Bechtel, Inc. (designer)	Shredding; air classification; magnetic and other mechanical separation	RDF for use by utility; bundled paper and corrugated; ferrous metals; aluminum; glassy aggregate	1600 TPD	18 (Plus 4.2 at Wisconsin Electric Power Co.)	Now operational at design capacity; RDF utilization problem at WEPCO due to boiler slagging on coal only, under evaluation; $4.6 million production improvement program held in abeyance pending evaluation	George Mallan Dir. of Operations & Marketing Americology American Can Co. GCP #8 Greenwich, Conn. 06830
Monroe County, N.Y.	County (owner); Raytheon Service Co. (designer)	Shredding; air classification; magnetic & other mechanical separation; froth flotation	RDF for use by utility; ferrous metals; nonferrous metals; mixed glass	2000 TPD	60.2[1]	Construction complete; startup began Sept. 1979	Howard Christensen Dir. of Solid Waste Department of Public Works 110 Colfax St. Rochester, N.Y. 14606
Nashville, Tenn.	Nashville Thermal Transfer Corp.; I.C. Thomasson & Assoc., Inc. (designer)	Thermal combustion	Steam for urban heating and cooling	400 TPD 7 days per week	24.5	Operational since 1974; recently upgraded two boilers to 530 TPD capacity each	Milton E. Kirkpatrick Exec. V.P. & Gen. Mgr. Nashville Thermal Transfer Corp. 110 First Ave. South Nashville, Tenn. 37201
Newark, N.J.	City; Combustion Equipment Assoc. and Occidental Petroleum Corp. (designers and operators)	Shredding; air classification; magnetic and other separation	Eco-Fuel II® for use by utility; ferrous metals; aluminum	3000 TPD (in 1000 TPD modules; to serve Newark's 700 TPD and surrounding community)	70 (for 3000 TPD) (initially 1000 TPD with a cost of $25 million including fuel user conversion)	Final contract signed 1977; site preparation began in Dec. 1978	(Same as Bridgeport, Conn.)
New Orleans, La.	City; Waste Management, Inc. (owner/operator); National Center for Resource Recovery, Inc. (designer/implementer)	Shredding; air classification; magnetic and other mechanical separation	Ferrous metals; aluminum and other nonferrous metals; glass	700 TPD	9.1[1]	Shredding/landfilling operational; recovering ferrous, aluminum, other nonferrous metals, glass in shakedown	Clifford Scineaux Deputy Director Dept. of Sanitation City Hall New Orleans, La. 70112
Niagara Falls, N.Y.	Hooker Energy Corp. (Hooker Chemicals & Plastics Corp.) (owner/operator)	Shredding; magnetic separation; burning shredded refuse	Steam and electricity for use by company complex; ferrous metals	2200 TPD	74 (appx.)	75% complete; mechanical completion April 1980	James Green Media Relations Hooker Chemical MPO Box 728 Niagara Falls, N.Y. 14302
Norfolk, Va. (U.S. Naval Station)	U.S. Navy (owner); Navy Public Works Center (operator); Metcalf & Eddy, Inc. (designer)	Mass burning in waterwall furnace	Steam (40,000 lbs/hr.) for use by Naval Station	360 TPD (two boilers, operated alternately)	2.2	Operational	Causey Simmons Head, Utilities Dept., Navy Public Works Center Norfolk, Va. 23511
Oceanside, N.Y.	Township of Hempstead (owner/operator); Charles R. Velzy (designer)	Mass burning in waterwall furnaces	Steam (60,000 lbs/hr.) in-plant use for electricity generation	750 TPD	9	Operational since 1965	Al Albanese Supt., Sanitation Township of Hempstead 1600 Merrick Rd. Merrick, N.Y. 11566
Orange County, Fla. (Walt Disney World)	U.S. Department of Energy, Idaho Operations Office; Reedy Creek Utilities Co.	Lagging pyrolysis incineration	High temperature water for heating and cooling	100 TPD	11 (appx.)	Demonstration plant; final design complete; groundbreaking scheduled for June 1980	Carl P. Gertz Project Mgr. U.S. Dept. of Energy 550 Second St. Idaho Falls, Idaho 83401

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Pinellas County, Fla.	County; Florida Power Corp; UOP, Inc.	Mass burning	Electricity; ferrous metals, aluminum and other nonferrous metals recovered after burning	14,000 tons per week	140	Final financial arrangements prior to bond sale; projected to begin construction this year; operational 1983	Don F. Acenbrack, Dir. Solid Waste Dept. of Public Works and Utilities Pinellas County 315 Court St. Clearwater, Fla. 33516
Pompano Beach, Fla.	Waste, Management, Inc.; U.S. Dept. of Energy; Jacobs Engineering Co. (designer)	Shredding; air classification; magnetic and other mechanical separation; anaerobic digestion of air classified light fraction with sewage sludge	Methane gas; carbon dioxide	50-100 TPD	3.65	Demonstration plant; operational	Peter J. Ware, Proj. Mgr. Waste Management, Inc. 900 Jorie Blvd. Oak Brook, Ill. 60521
Portsmouth, Va. (Norfolk Naval Shipyard)	U.S. Navy (owner); Public Works Dept., Norfolk Naval Shipyard	Mass burning in waterwall furnace	Steam (30,000 lbs/hr) for use by facilities at Naval Shipyard	160 TPD (two-80 TPD boilers; operated alternately)	4.5	Operational since 1976	Pete Cunanan NAVFAC ENG COM Environmental Quality Division Norfolk, Va. 23511
Portsmouth, Va. (Southeastern Tidewater Energy Project)	Southeastern Public Service Authority of Va.; Henningson, Durham & Richardson (architect/engineer); Day & Zimmerman (construction manager); Norfolk Naval Shipyard	Shredding; air classification; ferrous & nonferrous metals separation; burning RDF in semi-suspension, stoker-grate boiler	RDF; ferrous metals; nonferrous metals; steam & electricity for Shipyard	2000 TPD	144.9	Design 40% complete; site acquired; Environmental Impact Assessment approved; contract for sale of steam & electricity to Shipyard undergoing approval; construction to begin in early 1981	Durwood S. Curling Executive Director Southeastern Tidewater Energy Project 18 Koger Executive Center, Suite 127 Norfolk, Va. 23502
San Diego County, Calif.*	County; Occidental Petroleum Corp. (designer/operator)	Shredding; air classification; magnetic and other mechanical separation; froth flotation; pyrolysis	Pyrolytic oil, ferrous and nonferrous metals; glass	200 TPD	EPA—4.2 County—2 Occidental Petroleum 8.3	Demonstration plant: operations suspended after initial testing; further possible funding and modification being considered	John S. Burke, Dep. Dir. Solid Waste Dept. of Sanitation and Flood Control 5555 Overland Ave. San Diego, Calif. 92123
Saugus, Mass.	Thirteen communities including Saugus and part of northern Boston; RESCO (owner/operator)	Waterwall combustion; magnetic separation	Steam for electrical generation and industrial use; ferrous metals	1200 TPD (two boilers with 600-TPD capacity each)	50	Operational since 1975; expansion being considered	Joseph Ferrante Wheelabrator-Frye, Inc. Liberty Lane Hampton, N.H. 03842
Tacoma, Wash.	City (owner/operator); Boeing Engineering (designer)	Shredding; air classification; magnetic separation	RDF; ferrous metals	500 TPD	2.5[k]	Operational since 1979	Bill Larson, Proj. Mgr. Refuse Utility 740 St. Helens Ave. Room 304 Tacoma, Wash. 98402
Wilmington, Del.*	Delaware Solid Waste Authority; EPA; Raytheon Service Co. (designer)	Shredding; air classification; magnetic and other mechanical separation; froth flotation; aerobic digestion	Ferrous metals; nonferrous metals; glass; RDF; humus	1000 TPD municipal solid waste co-processed with 350 TPD of 20% solids digested sewage sludge	71.3[l] 7.4 from EPA OSW; 21.3 from EPA Water Prog; 7.1 from State matching grants; remainder from the Authority through sale of revenue bonds	Groundbreaking Aug. 1979; construction begun; startup expected in Nov. 1981	Pasquale S. Canzano Chief Engineer Delaware Solid Waste Authority P.O. Box 981 Dover, Del 19901

The following localities are either operating or constructing small modular combustion units to produce steam from mass combustion of municipal solid waste:

LOCATION	MANUFACTURER	REPORTED CAPACITY (TPD)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Auburn, Maine	Consumat	150	3.2	Design contract, funded by DOE, signed; energy use and operator contracts signed; construction began Aug. 1979; startup planned for Nov. 1980	Robert Belz Public Works Auburn City Hall 45 Spring St. Auburn, Maine 04210
Blytheville, Ark.	Consumat	75 to be processed	N/A	Temporarily shut down for installation of additional units	Tom Little, Mayor City Hall Blytheville, Ark. 72315
Crossville, Tenn.	Smokatrol	60	1.11	In shakedown; undergoing modifications	Nelson C. Walker Gen. Mgr. Environmental Services Corp. P.O. Box 765 Crossville, Tenn. 38555
Dyersburg, Tenn.	Consumat	100	2	Under construction; startup scheduled in early 1980	Alderman Bob Kirk Colonial Rubber Dyersburg, Tenn. 38024
Genesee Township, Mich.	Consumat	100	2.0	Began operations in Feb. 1980	Hanumanthaiya Marur, P.E. Township Engineer 7244 North Genesee Rd. Genesee, Mich. 48437
Groveton, N.H.	Environmental Control Products	24	N/A	Operational since 1975	Rick Coville Groveton Paper Mill, Inc. Groveton, N.H. 03582
Lewisburg, Tenn.	CICO	60	N/A	Under construction; to be in operation in July 1980	John D. Lambert City Manager 505 Ellington Pkwy., Rt. 1 Lewisburg, Tenn. 37091
North Little Rock, Ark.	Consumat	100	1.45	Operational 1976-1979; presently undergoing modifications. City awarded contract to Consumat Systems, Inc., for modifications and long-term operation; scheduled to re-open in March 1980	Mike Butner President U.S. Recycle Corp. P.O. Box 7561 Little Rock, Ark. 72217
Osceola, Ark.	Consumat	50	1.1	Began operations in Jan. 1980	R.E. Prewitt, Mayor City Hall Osceola, Ark. 72370
Pittsfield, Mass.	Vicon Recovery Assoc. (Enercon designed incinerators)	240	6.2[m]	Construction to be completed in Sept. 1980	Joseph J. Domas, Jr. President Vicon Recovery Assoc. P.O. Box 100 Butler Center Butler, N.J. 07405
Salem, Va.	Consumat	100	1.9	Operational in 1979	William Paxton, Jr. City Mgr. P.O. Box 869 Salem, Va. 24153
Siloam Springs, Ark.	Consumat	16	.4	Operational since Sept. 1975 (Presently being used as incinerator only)	Al Varwig, Dir. Sanitation Dept. 410 North Broadway Siloam Springs, Ark. 72761

In addition to the systems listed above, projects are underway to recover methane-containing gas mixtures from sanitary landfills which can be purified to pipeline quality:

LOCATION	KEY PARTICIPANTS	OUTPUT: GAS PRODUCED (MILLION FT^3/DAY)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Azusa, Calif.	Azusa Land Reclamation Co. (wholly owned subsidiary of the Southwestern Portland Cement Co.)	Low BTU gas	N/A	Began operations in April 1978	Ralph Rule Southwestern Portland Cement Co. 3055 Wilshire Blvd. Los Angeles, Calif. 90010
Cinnaminson, N.J.	Sanitary Landfill, Inc.; Public Service Electric & Gas Co.; Hoeganaes Corp.	Medium BTU gas; 1.0	N/A	Began operation in 1979; raw landfill gas used in-plant by Hoeganaes Corp.	Ken Matson Public Service Electric & Gas Co. of N.J. 80 Park Place Newark, N.J. 07101
Monterey Park, Calif.	Getty Synthetic Fuels, Inc.; Operating Industries, Inc.; Southern California Gas Co.	High BTU gas; 4.0	N/A	Operational August 1979	Frederick C. Rice Getty Synthetic Fuels, Inc. 2750 Signal Parkway Signal Hill, Calif. 90806
Mountain View, Calif.	City of Mountain View; EPA; Pacific Gas & Electric Co.; Dept. of Energy	High BTU gas; 0.5	0.85	Demonstration plant; currently operating and producing 0.25 MMSCFD of treated gas with a HHV of 750-800 BTU/SCF	Max Blanchet Pacific Gas & Elec. Co. 245 Market St. San Francisco, Calif. 94106
Palos Verdes, Calif.	Getty Synthetic Fuels, Inc.; Los Angeles County Sanitation District; Southern California Gas Co.	High BTU gas; .75	N/A	Operational since June 1975	(same as Monterey Park, Calif.)
Staten Island, N.Y. (Fresh Kills Landfill)	Brooklyn Union Gas Co., Inc.; New York City Resource Recovery Task Force; N.Y. State Energy Research and Development Authority; U.S. Dept. of Energy; Leonard S. Wegman, Inc.		N/A	Burner test of landfill gas in scaled-down furnace completed; construction begun on landfill gas electricity-generating facility to be on-line in summer 1980 for a one-year test, supplying 100 KW of electricity for on-site use	Anthony Giuliani Brooklyn Union Gas Co., Inc. 195 Montague St. Brooklyn, N.Y. 11201
Sun Valley, Calif. (Sheldon-Arleta Landfill Gas Recovery Project)	City of Los Angeles Departments of Public Works and Water & Power	Low BTU gas; 2.8	2.5	Operational	Mike Miller Sanitary Engineer L.A. Bureau of Sanitation Room 1410, City Hall East Los Angeles, Calif. 90012

The following localities reportedly are in advanced planning stages for resource recovery facilities, have issued Requests for Proposals, or are negotiating with bidders/contractors:

Appleton, Wis.
Beverly, Mass.
Calumet City, Ill.
Cincinnati, Ohio
Cuyahoga County, Ohio
Dubuque, Iowa
Gallatin, Tenn.
Hartford, Conn. (and surrounding area)
Honolulu, Hawaii
Martinez, Calif.
Memphis, Tenn.
Menlo Park, Calif.
New York, N.Y.
North Andover, Mass
North Hempstead, N.Y.
Oklahoma City, Okla.
Oyster Bay, N.Y.
Peabody, Mass
Rhode Island (state)
St. Paul, Minn.
San Diego, Calif.
San Leandro, Calif.
South/Central Conn.
Springfield, Mass. (and surrounding area)
Springfield, Mo.
Staten Island, N.Y.
Toledo, Ohio
Tulsa, Okla.
Westchester County, N.Y.

NOTE

ONLY THE FOLLOWING PAGES OF THIS PUBLICATION

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THE JOURNAL OF RESOURCE RECOVERY

National Center for Resource Recovery, Inc.

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This semiannual listing updates information on resource recovery facilities, controlled-air combustion units, and projects for recovering methane gas from landfills.

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One purpose of Recovery 1, the prototype resource recovery facility in New Orleans, has been to serve as a test bed for resource recovery processes and technology. This article describes NCRR's test and evaluation programs there and some modifications that have resulted from the testing.

RESOURCE RECOVERY ACTIVITIES

National Center for Resource Recovery, Inc.
1211 Connecticut Ave. N.W., Washington, D.C. 20036

For several years, NCRR has been tracking resource recovery activities in the U.S. and publishing periodic summaries. Because of the growing interest in systems to moderate solid waste disposal problems while recovering recyclables and energy products—plus a growing number of projects being undertaken—we have adapted the listing to a regular feature in every other issue of the *NCRR Bulletin*.

The listing is broken down into four segments: (1) capital-intensive energy and materials recovery facilities that are built, operating, in shakedown, under construction or in contract-signing stages; (2) smaller, controlled-air or modular combustion projects; (3) methane recovery from sanitary landfills projects; and (4) jurisdictions where commitments have been reported to undertake resource recovery projects. In addition to the systems listed here, a number of communities are magnetically separating ferrous metals and conducting source separation programs for old newspapers, etc.

Although every effort has been made to make this report complete and up-to-date, the dynamics of resource recovery are such that the status of projects can change at any time. For clarification or additional information, therefore, we suggest that you write directly to the contacts listed.

We are grateful for the review and input by the various project representatives, as well as that from local, state and federal officials.

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
CONNECTICUT							
Bridgeport	Conn. Resources Recovery Authority; Occidental Petroleum Corp. and Combustion Equipment Assoc. (designer/operator)	Shredding; magnetic separation, air classification; froth flotation	Eco-Fuel II® (powered fuel) for use in utility boiler; ferrous metals; nonferrous metals; glass	1800 tpd	53	Construction complete; start-up has begun; Eco-Fuel® in production and being test-burned at United Illuminating Co.	Barbara A. Koeth Public Information Manager Combustion Equipment Assoc. 555 Madison Ave. New York, N.Y. 10022
DELAWARE							
Wilmington	Delaware Solid Waste Authority; EPA; Raytheon Service Co. (designer)	Shredding; air classification; magnetic and other mechanical separation; froth flotation; aerobic digestion	Ferrous metals; nonferrous metals; glass; RDF; humus	1000 tpd municipal solid waste co-processed with 350 tpd of 20% solids digested sewage sludge	71.3 7.4 from EPA OSW; 21.3 from EPA Water Prog; 7.1 from State matching grants; remainder from the Authority through sale of revenue bonds	Groundbreaking Aug. 1979; construction begun; start-up expected in Nov. 1981	Pasquale S. Canzano Chief Engineer Delaware Solid Waste Authority P.O. Box 981 Dover, Del. 19901
FLORIDA							
Dade County	County; Black Clawson/Parsons & Whittemore, Inc. (designer)	Hydrasposal™ (wet pulping); magnetic and other mechanical separation	Steam for utility to produce electricity; aluminum; ferrous metals	3000 tpd	165	Contracts signed between County, P&W and Fla. Power & Light; pollution control bonds sold by state; construction began April 1979; completion scheduled for April 1981	Dennis Carter Asst. County Manager Room 911 Dade County Courthouse 73 W. Flagler St. Miami, Fla. 33130

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Lakeland	City (operator and joint owner with Orlando Utility Commission); C.T. Main, Inc. (power plant designer); Horner & Shifrin, Inc. (waste processing plant designer)	Shredding; magnetic separation; burning RDF with coal	Steam to produce electricity for use by City of Lakeland and Orlando Utility Commission; ferrous metals	300 tpd	5	Equipment purchased; construction begun; shakedown expected in mid-1981	Claude Hiers Supt. of Industrial Engineering & Business Affairs Box 368 Lakeland, Fla. 33802
Orange County (Walt Disney World)	U.S. Department of Energy, Idaho Operations Office; Reedy Creek Utilities Co.	Slagging pyrolysis incineration (Andco-Torrax)	High temperature water for heating and cooling	100 tpd	14	Demonstration plant; final design complete; construction began July 1980	Carl P. Gertz Project Mgr. U.S. Dept. of Energy 550 Second St. Idaho Falls, Idaho 83401
Pinellas County	County; Florida Power Corp.; UOP, Inc.	Mass burning	Electricity; ferrous metals, aluminum and other nonferrous metals recovered after burning	14,000 tons per week	160	Construction began Aug. 1980; operational in 36 months	Don F. Acenbrack, Director Solid Waste Dept. of Public Works and Utilities Pinellas County 315 Court St. Clearwater, Fla. 33516
Pompano Beach	Waste Management, Inc.; U.S. Dept. of Energy; Jacobs Engineering Co. (designer)	Shredding, air classification; magnetic and other mechanical separation; anaerobic digestion of air classified light fraction with sewage sludge	Methane gas; carbon dioxide	50-100 tpd	3.65	Demonstration plant; operational	Peter J. Ware, Proj. Mgr. Waste Management, Inc. 900 Jorie Blvd. Oak Brook, Ill. 60521
ILLINOIS							
Chicago (Northwest Incinerator)	City; Metcalf & Eddy, Inc. (designer)	Waterwall combustion	Steam for Brach Candy Co.; ferrous metals	1600 tpd	23	Operational since 1971; steam delivery expected to be on line in 1980	Emil Nigro Supervising Engineer Dept. of Streets & Sanitation Room 700 City Hall Chicago, Ill. 60602
Chicago (Southwest Supplementary Fuel Processing Facility)	City; Ralph M. Parsons Co. and Consoer, Townsend & Assoc. (designer)	Shredding; air classification; magnetic separation	RDF for use by utility; ferrous metals	1000 tpd	19	Temporarily off-stream to review experience to date and evaluate future operations; decisions pending	(Same as previous listing)
IOWA							
Ames	City; Gibbs, Hill, Durham & Richardson, Inc. (designer)	Bailing waste paper; shredding; magnetic separation; air classification; screening; other mechanical separation	Refuse-derived fuel for use by utility; baled paper; ferrous metals; aluminum, other nonferrous metals	200 tpd 50 tph	6.19	Operational since 1975	Arnold Chantland, Dir. Dept. of Public Works City Hall 5th and Kellog St. Ames, Iowa 50010
LOUISIANA							
New Orleans	City; Waste Management, Inc. (owner/operator); National Center for Resource Recovery, Inc. (designer/implementer)	Shredding; air classification; magnetic and other mechanical separation	Ferrous metals; aluminum and other nonferrous metals; glass	700 tpd	9.1	Shredding/landfilling operational; recovering ferrous; aluminum, other nonferrous metals, glass in shakedown	Clifford Scineaux Deputy Director Dept. of Sanitation City Hall New Orleans, La. 70112

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
MARYLAND							
Baltimore	City; EPA	Formerly Monsanto Landgard® process, now modified significantly by Baltimore City; includes shredding; pyrolysis; steam production; water quenching	Steam for use by city utility	600 tpd	30.1	Plant operating 24 hrs./day, 6 days/week	Ed May Baltimore City Pyrolysis Plant 1800 Annapolis Rd. Baltimore, Md. 21230
Baltimore County	County; Maryland Environmental Service; Teledyne National (designer/operator)	Shredding; air classification; magnetic separation	RDF; ferrous metals; glass for secondary products; aluminum	600-1500 tpd	8.4	Operational; recovering ferrous metals and producing secondary shredded and pelletized RDF; glass and aluminum recovery operational	Kenneth Cramer Teledyne National Padonia Centre Suite 401 30 E. Padonia Rd. Timonium, Md. 21093
MASSACHUSETTS							
Braintree	City (owner/operator); Camp, Dresser & McKee Inc. (designer)	Mass burning	Steam; producing ½ million lbs./day; selling ½ of steam production to Art & Leather Co.	250 tpd	2.8	Operational since 1971	Edward Courchene, Supt. Braintree Thermal Waste Reduction Center Ivory Street Braintree, Mass. 02184
East Bridgewater	City of Brockton and nearby towns; Combustion Equipment Assoc.; East Bridgewater Assoc.	Shredding; air classification; magnetic separation; other mechanical separation	Eco-Fuel II® for industrial boiler; ferrous metals	550 tpd being processed	10-12	Operational since 1977; plant has served as pilot operation for production of Eco-Fuel II®	(Same as Bridgeport, Conn.)
Saugus	Thirteen communities including Saugus and part of northern Boston; RESCO (owner/operator)	Waterwall combustion; magnetic separation	Steam for electrical generation and industrial use; ferrous metals	1200 tpd (two boilers with 600 tpd capacity each)	50	Operational since 1975; expansion being considered	Joseph Ferrante Wheelabrator-Frye, Inc. Liberty Lane Hampton, N.H. 03842
MICHIGAN							
Detroit	City	Shredding; air classification; magnetic separation; dedicated boilers	Steam and/or electricity for use by Detroit Edison; ferrous metals	3000 tpd	125	Negotiating with Combustion Engineering, Inc./Waste Resources Corp. prior to contract signing; steam to be purchased by Detroit Edison; State of Michigan environmental impact statement being prepared	Michael Brinker Dept. of Public Works City of Detroit City-County Bldg., Room 513 Detroit, Mich. 48226
MINNESOTA							
Duluth	Western Lake Superior Sanitary District (operator); Consoer, Townsend & Assoc. (engineer)	Shredding; magnetic separation; air classification; secondary shredding; fluidized bed incineration of RDF and sludge	RDF; ferrous metals; steam for heating and cooling of plant and to run process equipment	400 tpd of MSW; 340 tpd of 20% solids sewage sludge	19	Full operations scheduled for Fall 1980	John Klaers Western Lake Superior Sanitary Dist. 27th Ave. West & The Waterfront Duluth, Minn 55806
NEW JERSEY							
Newark	City; Combustion Equipment Assoc and Occidental Petroleum Corp. (designers and operators)	Shredding; air classification; magnetic and other separation	Eco-Fuel II® for use by utility; ferrous metals; aluminum	3000 tpd (in 1000 tpd modules); to serve Newark's 700 tpd and surrounding community	70 (for 3000 tpd) (initially 1000 tpd with a cost of $25 million including fuel user conversion)	Final contract signed 1977; site preparation completed	(Same as Bridgeport, Conn.)

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
NEW YORK							
Albany	City and 10 nearby communities; Smith & Mahoney (designer/project mgr.)	Shredding; magnetic separation; burning in semi-suspension, stoker-grate boiler; nonferrous recovery from boiler ash	RDF; ferrous metals; steam for urban heating and cooling; nonferrous metals	750 tons per shift	26.6 (11.6 processing plant; 15 steam plant)	Construction completed in March 1980; processing in operation; steam generating facility operational in 1981	Patrick Mahoney Smith & Mahoney 40 Steuben St. Albany, N.Y. 12207
Glen Cove	City (owner/operator); William F. Cosulich and Ernest F. W. Frank (designer)	Mass burning in stoker-fired furnace with vacuum filtered sewage sludge	Steam for electricity for use at sewage plant	225 tpd	34 ($22 M for mass burning unit; $12 M for sewage plant)	Sewage plant and incinerator unit under construction	Joseph P. Hurley Director of Public Works City Hall Bridge St. Glen Cove, N.Y. 11542
Hempstead	Town; Hempstead Resource Recovery Corp. (Div. of Black Clawson/Parsons & Whittemore, Inc.) (owner/operator)	Hydrasposal™ (wet pulping); magnetic and mechanical separation; burning of RDF product in air-swept spout spreader stoker boilers	Electricity from utility-owned turbine generators; color-sorted glass; aluminum; ferrous metals	2000 tpd (150 tph)	130	in shakedown; temporarily shut down due to contractual dispute; also closed by joint agreement between Town and HRRC until EPA establishes uniform standards for testing of dioxins	D.C. Cullingham VP & Gen. Mgr. Hempstead Resource Recovery Corp. Roosevelt Field Station Garden City East, N.Y. 11530
Monroe County	County (owner); Raytheon Service Co. (designer)	Shredding; air classification; magnetic & other mechanical separation; froth flotation	RDF for use by utility; ferrous metals; nonferrous metals; mixed glass	2000 tpd	60.2	Construction complete; startup began Sept. 1979	Howard Christensen Dir. of Solid Waste Department of Public Works 110 Colfax St. Rochester, NY 14606
Niagara Falls	Hooker Energy Corp. (Hooker Chemicals & Plastics Corp.) (owner/operator)	Shredding; magnetic separation; burning shredded refuse	Steam and electricity for use by company complex; ferrous metals	2200 tpd	74 (appx.)	In startup; full operation expected in Oct. 1980	James Green Media Relations Hooker Chemical MPO Box 728 Niagara Falls, N.Y. 14302
Oceanside	Township of Hempstead (owner/operator); Charles R. Velzy (designer)	Mass burning in waterwall furnace	Steam (60,000 lbs./hr.) in-plant use for electricity	750 tpd	9	Operational since 1965	Al Albanese Supt., Sanitation Township of Hempstead 1600 Merrick Rd. Merrick, N.Y. 11566
Westchester County (Peekskill)	County & 34 municipalities; UOP, Inc.	Mass burning in waterwall furnace	Steam and electricity for sale to utility	1500 tpd	100	Negotiations underway with UOP, Inc., for full-service contract; construction expected to begin mid to late 1981 with operations in Jan. 1984	Edward K. Davies Deputy Commissioner, Solid Waste Mgmt. Room 522, County Office Bldg. White Plains, N.Y. 10601
OHIO							
Akron	City; Glaus, Pyle, Schomer, Burns & De Haven; Ruhlin Const. Co.; Babcock & Wilcox Co. (boiler supplier); Teledyne National (operator)	Shredding; air classification; magnetic separation; burning RDF in semi-suspension, stoker-grate boiler	Steam for urban and industrial heating and cooling; ferrous metals	1000 tpd	55	In shakedown; fully operational in Sept. 1980	Dave Chapman 203 Municipal Bldg. 166 South High St. Akron, Ohio 44308

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Columbus	City; Alden E. Stilson Assoc. (designer)	Shredding; magnetic separation; burning of shredded refuse with supplemental coal in semi-suspension stoker-grate boiler to produce steam; generation of electricity from steam	Electricity for City customers	2000 tpd	127	Equipment being purchased; site preparation began July 1979; piling begun for foundations; operational in late 1982	Henry Bell, Supt. Div. of Electricity 50 W. Gay St. Columbus, Ohio 43215
OREGON							
Lane County	County; Allis-Chalmers Corp. (designer); Western Waste Corp. (operator)	Shredding; air classification; magnetic separation	RDF; ferrous metals	500 tpd	2.1	Closed in Nov. 1979 for repairs and modifications following explosion; began pre-acceptance testing in Spring 1980, but has not met all contract specifications; awaiting further action by designer	Mike Turner Adm. Analyst Lane County Solid Waste Mgt. Div. Environmental Mgt. Dept. 125 East 8th St. Eugene, Ore. 97401
PENNSYLVANIA							
Harrisburg	City; Gannett, Fleming, Corddry and Carpenter, Inc. (designer)	Waterwall combustion; bulky waste shredding (steam driven) magnetic separation; sewage sludge drying	Steam for utility-owned district heating system and for city-owned sludge drying systems; ferrous metals	720 tpd	8.3	Operational since Oct. 1972; steam sale to utility began Dec. 1978; sludge drying facility started early 1980	Paul W. Bricker Gannett, Fleming, Corddry and Carpenter, Inc. P.O. Box 1963 Harrisburg, Pa. 17105
TENNESSEE							
Gallatin	Sumner County; Cities of Gallatin and Hendersonville; Sanders & Thomas, Inc. (designer)	Mass burning in waterwall rotary combustor	Steam for industrial processing and electricity generation	200 tpd	8.1	Under construction; completion in July 1981	Jerry H. Metcalf Project Manager P.O. Box 967 Gallatin, Tenn. 37066
Nashville	Nashville Thermal Transfer Corp.; I.C. Thomasson & Assoc., Inc. (designer)	Thermal combustion	Steam for urban heating and cooling	400 tpd 7 days per week	24.5	Operational since 1974; recently upgraded two boilers to 530 TPD capacity each	Milton E. Kirkpatrick Exec. V.P. & Gen. Mgr. Nashville Thermal Transfer Corp. 110 First Ave. South Nashville, Tenn 37201
VIRGINIA							
Hampton	City; NASA Langley Research Center; U.S. Air Force at Langley Field; J.M. Kenith Co. (designer/builder)	Mass burning	Steam for use by NASA Langley Research Center	200 tpd	10.3	Plant operational July 1980	Frank H. Miller, Jr. Dir. of Public Works Hampton, Va. 23669
Norfolk (U.S. Naval Station)	U.S. Navy (owner); Navy Public Works Center (operator); Metcalf & Eddy, Inc. (designer)	Mass burning in waterwall furnace	Steam (40,000 lbs./hr) for use by Naval Station	360 tpd (two boilers operated alternately)	2.2	Operational	Richard Eitel Head, Utilities Dept. Navy Public Works Center Norfolk, Va. 23511
Portsmouth (Norfolk Naval Shipyard)	U.S. Navy (owner); Public Works Dept., Norfolk Naval Shipyard	Mass burning in waterwall furnace	Steam (30,000 lbs./hr) for use by facilities at Naval Shipyard	160 tpd (two-80 tpd boilers, operated alternately)	4.5	Operational since 1976	Pete Cunanan NAVFAC ENG COM Environmental Quality Division Norfolk, Va 23511

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Portsmouth (Southeastern Tidewater Energy Project)	Southeastern Public Service Authority of Va.; Henningson, Durham & Richardson (architect/engineer); Day & Zimmerman (construction manager); Norfolk Naval Shipyard	Shredding; air classification; ferrous & nonferrous metals separation; burning RDF in semi-suspension, stoker-grate boiler	RDF; ferrous metals; nonferrous metals; steam & electricity for Shipyard	2000 tpd	144.9	Design 40% complete; site acquired; Environmental Impact Assessment approved; contract for sale of steam & electricity to Shipyard being negotiated; construction to begin following completion of negotiations & contract approval process	Durwood S. Curling Executive Director Southeastern Tidewater Energy Project 16 Koger Executive Center, Suite 129 Norfolk, Va. 23502
WASHINGTON							
Tacoma	City (owner/operator); Boeing Engineering (designer)	Shredding; air classification; magnetic separation	RDF; ferrous metals	500 tpd	2.5	Operational since 1979	Bill Larson, Proj. Mgr. Refuse Utility 740 St. Helens Ave. Room 304 Tacoma, Wash. 98402
WISCONSIN							
Madison	City and M. L. Smith Enviromental (designer); Madison Gas & Electric Co. (RDF user)	Shredding; magnetic separation; separation of combustibles and non-combustibles; secondary shredding air swept	RDF for use by Madison Gas & Electric Co; ferrous metals	400 tpd (max)(200 tpd being processed)	2.5	Process plant & boiler firing facility operational	Robert Vetter Div. of Engineering Room 115 City-County Bldg. Madison, Wis. 53709
Milwaukee	City; (to expand to surrounding Milwaukee County areas); Americology Div. of American Can Co. (owner/operator); Bechtel, Inc. (designer)	Shredding; air classification; magnetic and other mechanical separation	RDF for use by utility; bundled paper and corrugated; ferrous metals; aluminum; glassy aggregate	1600 tpd	18 (Plus 4.2 at Wisconsin Electric Power Co.)	Now operational at design capacity; RDF utilization problem at WEPCO due to boiler slagging on coal only, under evaluation; $4.6 million production improvement program held in abeyance pending evaluation	George Mallan Dir. of Operations & Marketing Americology American Can Co. GOP #8 Greenwich, Conn. 06830
Waukesha	City; Donohue & Assoc. (incinerator designer); Sanders & Thomas, Inc. (heat recovery system designer)	Mass burning in refractory furnace; waste heat recovery	Steam for local industry and sewage treatment plant	120 tpd (burning) 175 tpd (design)	Incinerator 1.7 (1971); Heat recovery system 3.9 (1979)	Incinerator operating since 1971; waste heat recovery boiler added in 1979; operating and sending steam to local industry; sewage plant under construction and will be ready for steam in July 1981	Rodney Vanden Noven Dir. of Public Works 201 Delafield St. Waukesha, Wis. 53186

The following localities are either operating or constructing small modular combustion units to produce steam from mass combustion of municipal solid waste:

LOCATION	MANUFACTURER	REPORTED CAPACITY (tpd)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
ARKANSAS					
Batesville	Consumat	50	1	Under construction; operation expected in early 1981	Peyton Golden, Mayor Municipal Bldg. 170 S. Forth St. Batesville, Ark. 75201
Blytheville	Consumat	75 to be processed	N/A	Temporarily shut down for installation of additional units	Tom Little, Mayor City Hall Blytheville, Ark. 72315

LOCATION	MANUFACTURER	REPORTED CAPACITY (tpd)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
North Little Rock	Consumat	100	1.45	Operational	Mike Butner President U.S. Recycle Corp. P.O. Box 7561 Little Rock, Ark. 72217
Osceola	Consumat	50	1.1	Began operations Jan. 1980	R. E. Prewitt, Mayor City Hall Osceola, Ark. 72370
Siloam Springs	Consumat	16	.4	Began operations in Sept. 1975 (Presently used as incinerator only)	Al Varwig, Dir. Sanitation Dept. 410 N. Broadway Siloam Springs, Ark. 72761
CONNECTICUT					
Windham	Consumat	108	3.7	Construction to begin by Nov. 1980; startup expected in Summer 1981	Ken Williams First Selectman Town of Windham Town Office, 979 Main St. Willimantic, Conn. 06226
IDAHO					
Burley	Consumat	50	1.5	Operation expected by end of 1980	Norman Dayley County Commissioner Cassia County Court House Burley, Idaho 83318
MAINE					
Auburn	Consumat	200	3.9	Startup planned for Nov. 1980	Robert Belz Public Works Auburn City Hall 45 Spring St. Auburn, Maine 04210
MASSACHUSETTS					
Pittsfield	Vicon Recovery Assoc. (Enercon designed incinerator)	240	6.2	Construction to be completed in Sept. 1980	Joseph J. Domas, Jr. President Vicon Recovery Assoc. P.O. Box 100 Butler Center Butler, N.J. 07405
MICHIGAN					
Genesee Township	Consumat	100	2.0	Began operations in Feb. 1980; 3-shift operations on non-interruption basis began August 1980	Hanumanthaiya Marur, P.E. Township Engineer 7244 N. Genesee Rd. Genesee, Mich. 48437
NEW HAMPSHIRE					
Durham (Lamprey Regional Solid Waste Cooperative)	Consumat	108	3.3	Operations expected by Sept. 1, 1980	Malcolm Chase, Chairman Lamprey Regional Solid Waste Cooperative 13-15 Newmarket Rd. Durham, N.H. 03824
Groveton	Environmental Control Products	24	N/A	Operational since 1975	Rick Coville Groveton Paper Mill, Inc. Groveton, N.H. 03582
TENNESSEE					
Crossville	Smokatrol, modified by Environmental Services Corp.	60	1.11	In shakedown	Nelson C. Walker Gen. Mgr. Environmental Services Corp. P.O. Box 765 Crossville, Tenn. 38555
Dyersburg	Consumat	100	2	Startup scheduled for Aug. 1980	Alderman Bob Kirk Colonial Rubber Dyersburg, Tenn. 38024

LOCATION	MANUFACTURER	REPORTED CAPACITY (tpd)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Lewisburg	CICO	60	N/A	In shakedown	John D. Lambert City Manager 505 Ellington Pkwy. Rt. 1 Lewisburg, Tenn. 37091
TEXAS					
Gatesville (Texas Dept. of Corrections)	Consumat	7	.2	Under construction; operations expected in early 1981	R. E. Howell Chief, Bldg. & Eng. Mgmt. Construction Div. Texas Dept. of Corrections P.O. Box 99 Huntsville, Texas 77340
Palestine (Beto Unit, Texas Dept. of Corrections)	Consumat	28	.3	Under construction; operations expected in early 1981	(same as Gatesville, Texas)
VIRGINIA					
Newport News (Ft. Eustis)	Consumat	40	1.4	Under construction; operation expected in early 1981	Ed Shuford Area Engineer Southern Va. Area Office P.O. Drawer B Ft. Eustis, Va. 23604
Salem	Consumat	100	1.9	Operational since 1979	William Paxton, Jr. City Manager P.O. Box 869 Salem, Va. 24153

Projects are underway in the following localities to recover methane-containing gas mixtures from sanitary landfills which can be purified to pipeline quality:

LOCATION	KEY PARTICIPANTS	OUTPUT: GAS PRODUCED (MILLION FT³/DAY)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
CALIFORNIA					
Azusa	Azusa Land Reclamation Co. (wholly owned subsidiary of the Southwestern Portland Cement Co.)	Low Btu gas	N/A	Began operations in April 1978	Ralph Rule Southwestern Portland Cement Co. 3055 Wilshire Blvd. Los Angeles, Calif. 90010
Monterey Park	Getty Synthetic Fuels, Inc.; Operating Industries, Inc.; Southern California Gas Co.	High Btu gas; 4.0	N/A	Began operations in August 1979	Frederick C. Rice Getty Synthetic Fuels, Inc. 2750 Signal Parkway Signal Hill, Calif. 90806
Mountain View	City of Mountain View; EPA; Pacific Gas & Electric Co.; Dept. of Energy	High Btu gas; 0.5	.85	Demonstration plant; currently operating and producing 0.25 MMSCFD of treated gas with a HHV of 750-800 Btu/SCF	Max Blanchet Pacific Gas & Elec. Co. 245 Market St. San Francisco, Calif. 94106
Palos Verdes	Getty Synthetic Fuels, Inc.; Los Angeles County Sanitation District; Southern California Gas Co.	High Btu gas; .75	N/A	Began operations in June 1975	(same as Monterey Park, Calif.)
San Leandro	Getty Synthetic Fuels, Inc.; Oakland Scavenger Co.	Medium Btu gas	N/A	Operations scheduled for late 1980	(same as Monterey Park, Calif.)

LOCATION	KEY PARTICIPANTS	OUTPUT: GAS PRODUCED (MILLION FT³/DAY)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Sun Valley (Sheldon-Arleta Landfill Gas Recovery Project)	City of Los Angeles Departments of Public Works and Water & Power	Low Btu gas; 2.8	2.5	Operational	Mike Miller Sanitary Engineer L.A. Bureau of Sanitation Room 1410, City Hall East Los Angeles, Calif. 90012
Wilmington	SCS Engineers; Watson Energy Systems, Inc.; Compressor Systems, Inc.	1.5	N/A	Operational	Joseph V. Seruto Vice Pres.—Methane Operations Watson Energy Systems, Inc. 22010 S. Wilmington Ave. Suite 207 Carson, Calif. 90745
NEW JERSEY					
Cinnaminson	Sanitary Landfill, Inc.; Public Service Electric & Gas Co.; Hoeganaes Corp.	Medium Btu gas; 0.6	N/A	Began operations in 1979; raw landfill gas used in-plant by Hoeganaes Corp.	Ken Matson Public Service Electric & Gas Co. of N.J. 80 Park Place Newark, N.J. 07101
NEW YORK					
Staten Island (Fresh Kills Landfill)	Brooklyn Union Gas Co., Inc.; New York City Office of Resource Recovery & Waste Disposal; N.Y. State Energy Research & Development Authority; U.S. Dept. of Energy; Leonard S. Wegman, Inc.		N/A	Burner test of landfill gas in scaled-down furnace completed; landfill gas electricity-generating facility supplying 100 KW of electricity for on-site use for one-year test expected to be online in Sept. 1980	Anthony Giuliani Brooklyn Union Gas Co., Inc. 195 Montague St. Brooklyn, N.Y. 11202
ILLINOIS					
Calumet City	Getty Synthetic Fuels, Inc.; Waste Management, Inc.; Natural Gas Pipeline Co. of America		N/A	Construction began July 1980; operation scheduled for Dec. 1980	(same as Monterey Park, Calif.)

The following localities reportedly are in advanced planning stages for resource recovery facilities, have issued Requests for Proposals, or are negotiating with bidders/contractors:

ALABAMA
- Huntsville (Redstone Arsenal)

CALIFORNIA
- Martinez
- San Diego

CONNECTICUT
- Hartford (and surrounding area)
- South/Central Connecticut

FLORIDA
- Dade County

HAWAII
- Honolulu

IOWA
- Dubuque

MARYLAND
- Prince Georges County

MASSACHUSETTS
- Boston
- Haverhill/Lawrence
- North Andover
- Peabody
- Springfield (and surrounding area)

MINNESOTA
- St. Paul

MISSOURI
- Springfield

NEW YORK
- Cattaraugus County
- Babylon, Huntington, Islip (Multi-Town Authority)
- New York City
- Oyster Bay
- Staten Island

OHIO
- Cincinnati
- Cuyahoga County
- Toledo

OKLAHOMA
- Oklahoma City
- Tulsa

OREGON
- Portland

RHODE ISLAND
- State of Rhode Island

TENNESSEE
- Memphis
- Nashville

WISCONSIN
- Appleton

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ERRATA

Page 70 Column 3, line 9

97 3/4 *should read* 97 1/2

Page 72 Column 2, line 5

seven *should read* one